Fire Detection and Alarm System (FDAS)

Components Design & Installation Standards

Resource Speaker : Engr. Angelo N. Olermo, ECE

September 15, 2024

Resource Speaker's Profile

- I am an Electronics Engineer and graduated from Mapua Institute of Technology at Intramuros Manila.

- Professional Organization Affiliations:
  - Member of Institute of Electronics Engineers of the Philippines (IECEP) Manila Chapter and Building Electronics & Auxiliary Systems Society (BEASS).
  - Philippine Integrated Fire Protection Organization (PIFPO)
    - Member of PIFPO Codes & Standards Committee.
    - PIFPO Taguig Chapter Vice President (External Affairs & Stakeholders Relations).

Resource Speaker's Background in FDAS

- I started as a FDAS operator for a property management company of a high-rise building.

- I previously worked from an exclusive distributor company of an Edwards brand in the Philippines.
  - I supervised the installation, testing, commissioning, servicing, and maintenance of FDAS.
  - I accomplished factory certification for the installation, programming, and networking of Edwards EST3 Life Safety Control Platform.

- I am currently working for an outsourcing company to provide design and preparation of submittal documents for the different suppliers of FAS in the USA.
  - I do plans review in preparation for the design of FAS including the drawings, calculations, equipment specifications, and bill of materials.
  - I accomplished certification for the Edwards ModuLaser Air Sampling Smoke Detection System.
  - I accomplished FAS certification from National Institute for Certification in Engineering Technologies (NICET) at Guam, USA.

Disclaimer

This webinar and its content is not a formal interpretation issued pursuant to the National Fire Protection Association (NFPA) codes and standards, the Fire Code of the Philippines Revised Implementing Rules and Regulation, nor the Philippine Electronics Code Book 2 for FDAS. Opinions expressed during the webinar are personal opinions of the presenter and does not necessarily represent the official position of the NFPA Technical Committee, the BFP Fire Safety Enforcement Division, the IECEP FDAS Technical Working Group, the PIFPO Code and Standards Committee or any other affiliated industry organizations mentioned therein and shall only be treated as a personal knowledge sharing for educational purposes only and shall not be used as a legal or professional advice for any existing fire and life safety projects.

Webinar Objectives:

- To be aware on the Classification of Occupancy as per RA 9514 - Revised IRR - 2019.
- To be aware on the Fire Detection & Alarm System components design and installation standards.

Webinar Outline:

- Overview of the Classification of Occupancy as per RA 9514 - Revised IRR - 2019.
- Fire Detection & Alarm System components design and installation standards.

Fire Detection & Alarm System

Definition

RA 9514 - Revised IRR - 2019
Rule 3:

Fire Detection & Alarm System (FDAS)
A system that detects fire at the earliest stage, and gives an alarm to alert the occupants so that appropriate action can be taken.

Fire Alarm
Any visual or audible signal produced by a device or system to warn the occupants of the building or fire fighting elements of the presence or danger of fire.

NFPA 72 - 2022

Fire Alarm System

3.3.118 A system or portion of a combination system that consists of components and circuits arranged to monitor and annunciate the status of fire alarm or supervisory signal-initiating devices and to initiate the appropriate response to those signals.

The Fire Detection and Alarm System industry are Code and Standard driven for the following reasons:

- To provide **Safety**. *(Codes)*
- To increase the **Effectiveness**. *(System Standards)*
- To increase the **Reliability**. *(Product Standards)*

NFPA 72 - 2022

3.2.2 **Authority Having Jurisdiction (AHJ)**. An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.6 **Shall**. Indicates a mandatory requirement.

3.2.7 **Should**. Indicates a recommendation or that which is advised but not required.

Codes

- *Provides minimum requirements.*
- *Codes specify "When" and "Where" certain types of protection are required.*
- *Codes are written rules and regulations that the AHJ adopt as law.*

Standards

- *Provides guidance on proper installation, maintenance, and testing.*
- *Details "How" the components that provide the level of protection required by the Code should operate.*

Here are the codes and standards which play the most important role in the design and installation of Fire Detection and Alarm System:

1.) RA 9514 (The Fire Code of the Philippines) and
NFPA 101 (Life Safety Code)
When and Where Fire Detection and Alarm System are required (Classification of Occupancy).

2.) PELC Book 2 (Philippine Electronics Code for FDAS) and
NFPA 72 (National Fire Alarm and Signaling Code)
How to install Fire Alarm equipment and devices.

3.) PEC (Philippine Electrical Code) and
NFPA 70 (National Electrical Code)
Wiring protection requirements for Fire Detection and Alarm System.

Product Standards

NFPA 72 - 2022

10.3.1 Equipment constructed and installed in conformity with this Code shall be **listed for the purpose for which it is used**.

3.2.5 **Listed**
Equipment, materials, or services included in a **list published by an organization that is acceptable to the authority having jurisdiction** and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

Product Listings Agency Standards

UL – Underwriters Laboratories

*Founded in 1894 and it is an **US-American product certifier**. UL specializes in testing and listing equipment for performance. UL also provides listing for monitoring companies, installing companies and for actual fire alarm systems that are installed at a specific facility.*

Factory Mutual (Now FM Global)

*Founded in 1835, the US-based FM Global (Factory Mutual Insurance Company) is an international insurance company that provides title insurance and risk management solutions. **FM Approvals is a department of FM Global that certifies industrial, commercial products and services for companies. FM Approvals is an international leader in third-party testing and certification services**. In order to prevent property damage, it ensures that products and services meet the highest quality, technical integrity and performance standards for use in commercial and industrial facilities. If a product or service complies with the standards of FM Approvals, then the product is marked with "FM APPROVED". A total of 45,000 types products and systems have been certified by FM so far, and these products are published in FM Approval Guide, the official website of FM. Just like NFPA, FM has its own standards and although these standards are similar to each other, FM standards are stricter than NFPA standards.*

Product Listings Agency Standards (Continuation)

LPCB – Loss Prevention Certification Board

*The Loss Prevention Certification Board is a part of the BRE (Building Research Establishment) Group. The BRE Group focuses on research, consultancy and testing in the building industry. **Among their services are also certifications and acceptances in the field of fire protection and safety**. These certifications under the marking and logo of the LPCB are mostly important in Great Britain, the Middle East and the Asia-Pacific region. Just as with the VdS, the LPCB uses **EN** and **ISO** standards as well as their own guidelines as a basis for certification. Meanwhile, there is a cooperation between VdS and the LPCB with the aim of recognizing the existing certifications and testing and thus to simplify and to speed up the certification process.*

VdS – Schadenverhutung GmbH

*With its headquarters in Cologne, is today one of the most renowned institutions for corporate safety, with a focus on fire protection, security and natural hazard prevention. Among the services that the company offers, in addition to the **certification of products**, are also risk assessment, testing of equipment and a broad educational offering. Particularly in fire protection, the VdS seal of approval enjoys an excellent reputation and is required on all equipment used within fire protection within German-speaking countries. As the basis for being marked with the VdS seal of approval, there is an acceptance procedure based on the applicable DIN, **EN** and **ISO** standards as well as VdS's own guidelines.*

Product Listings Agency Standards (Continuation)

LPCB and VdS are certification agencies that tests and certifies based on EN and ISO standards.

EN *is a Product-based Standards and the* ***ISO*** *is a Process-based Standards.*

For Fire and Life Safety, the ***Product Standard Certification*** *shall be* ***Product-based*** *and not Process-based.*

Product Listings Agency Standards (Continuation)

Are we required to install UL listed equipment?

NFPA 72 (National Fire Alarm and Signaling Code) is a Prescriptive Code that prescribes the minimum requirement.

This does not restrict the use of the fire alarm products manufactured in accordance with other fire alarm standards, such as EN-54, as long as the system will be designed, installed, and tested in accordance with NFPA 72 (National Fire Alarm and Signaling Code).

Equivalency

NFPA 72 - 2022

1.5.1 Nothing in this Code shall prevent the use of systems, methods, devices, or appliances of **equivalent** or **superior** quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this Code.

1.5.2 Technical documentation shall be submitted to the authority having jurisdiction **to demonstrate** equivalency.

1.5.3 The systems, methods, devices, or appliances that are found equivalent shall be approved.

Equivalency (Continuation)

**Technical documentation that demonstrates equivalency do not include the manufacturer's published technical or sales catalog sheets and brochures.*

*Examples of **Technical Documentation** include:*

- *Testing laboratory reports*
- *Engineering calculations*
- *Experiential data*
- *Documented engineering judgments*

Equivalency (Continuation)

Fire safety regulations

Equivalence of norms

ISO standards are internationally agreed by experts. Think of them as a formula that describes the best way of doing something. It could be about making a product, managing a process, delivering a service or supplying materials – standards cover a huge range of activities.

Category	UL	ISO 7240	EN-54
Control and indicating equipment	864	2	2
Fire alarm devices - sounders	464	3	3
Power supply equipment	1481	4	4
Heat detectors	521	5, 8	5
Smoke detectors	268	7	7
Test fires for fire detectors	Note 3	9	9
Flame detectors	ANSI/FM3260	10	10
Manual call points	38	11	11
Compatibility assessment of system components	Note 4	13	13
Multi-sensor fire detectors	268/521	15	15
Voice alarm control and indicating equipment	864/1711	16	16
Short-circuit isolators	864	17	17
Input/output devices	864	18	18
Alarm transmission and fault warning routing equipment	864	21	21
Fire alarm devices - visual alarms	1971	23	23
Components of voice alarm systems - loudspeakers	1480	24	24

© Robert Bosch GmbH 2023. All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights.

BOSCH

RA 9514 - Revised IRR - 2019

SECTION 10.2.6.6 FIRE DETECTION, ALARM, AND COMMUNICATION SYSTEMS

A. General
1. Fire detection, alarm, and communication systems if required by Division 8 through 20 of this Chapter shall be in accordance with the ***NFPA 72, National Fire Alarm and Signaling Code****, or latest edition of* ***Philippine Electronics Code*** *and* ***Philippine Electrical Code****.*

**The requirements will be based on the storeys, units, area, and number of occupants for each occupancy.*

Classification of Occupancy (Division 8 through 20):

- *Places of Assembly*
- *Educational*
- *Day Care*
- *Health Care*
- *Residential Board and Care*
- *Detention and Correctional*
- *Residential*
- *Mercantile*
- *Business*
- *Industrial*
- *Storage*
- *Special Structures*
- *High Rise Buildings*

Classification of Occupancy (Division 8 through 20)

Republic of the Philippines
Department of the Interior and Local Government
BUREAU OF FIRE PROTECTION
NATIONAL HEADQUARTERS
Agham Road, Sitio San Roque, Brgy. Bagong Pag-asa, Quezon City
Telefax Number: (02) 426 – 4399
Email: cdsnhq12345@gmail.com

MEMORANDUM

TO: ALL REGIONAL DIRECTORS

SUBJECT: CORRECTED VERSION OF SUMMARIZED GUIDE FOR FIRE SAFETY INSPECTORS ON THE FIRE SAFETY REQUIREMENTS OF DIFFERENT TYPES OF OCCUPANCY

DATE: 22 July 2021

1. Reference:
   a. Republic Act 9514 and its Revised Implementing Rules and Regulations; and
   b. Memorandum dated 21 July 2021 re: Summarized Guide for Fire Safety Inspectors on the Fire Safety Requirements of Different Types of Occupancy

2. As requested by most local fire stations, attached is the corrected version of summarized guide on the fire safety requirements such as Automatic Fire Suppression System, Standpipe System, Fire Detection Alarm and Communication System and Portable Fire Extinguisher of different types of occupancy which may help the Fire Safety Inspectors in the conduct of their duty.

3. For your information and ready reference

BY COMMAND OF THE CHIEF, BFP

JAIME DOLLENTE RAMIREZ
CSUPT (DSC) BFP
Director for Fire Safety and Enforcement

Chief, FSED:

RECEIVED
DATE 7/26/21 BY

jmbb/atm/2021/Memo/06-17All-RDs-Guide for FSI

Type of Occupancy	Automatic Fire Suppression System	Standpipe System	Fire Detection Alarm and Communication System		Portable Fire Extinguisher
			Manual	Automatic	
MERCANTILE **CLASS A** 2,788sq.m. or more than 3 floors **CLASS B** less than 2,787 sq.m but more than 279 sq.m **CLASS C** 278 sq.m below the street floor	a. Three (3) or more storeys in height (at least one of the floor is 232 sq.m) b. Exceeding 1,115 sq.m in gross area. c. Below street floors exceeding 232 sq.m used for sale, storage or handling of combustible goods and merchandise	a. 4 or more storeys in height b. Exceeding 1,860 sq.m. per floor	Class C	Class A and Class B	Required
EDUCATIONAL	a. building is 15 m or more in height b. basement used as a classroom or laboratory	a. 4 or more storeys in height	Every educational building	If the building is provided with automatic fire suppression systems	Required
STORAGE	Every high hazard occupancy	Exceeding 1,860 sq.m. per floor	Ordinary or low hazard building not exceeding 2000 sq.m	All storage occupancies except ordinary or low hazard building not exceeding 2000 sq.m	Required

Classification of Occupancy (Division 8 through 20) (Continuation)

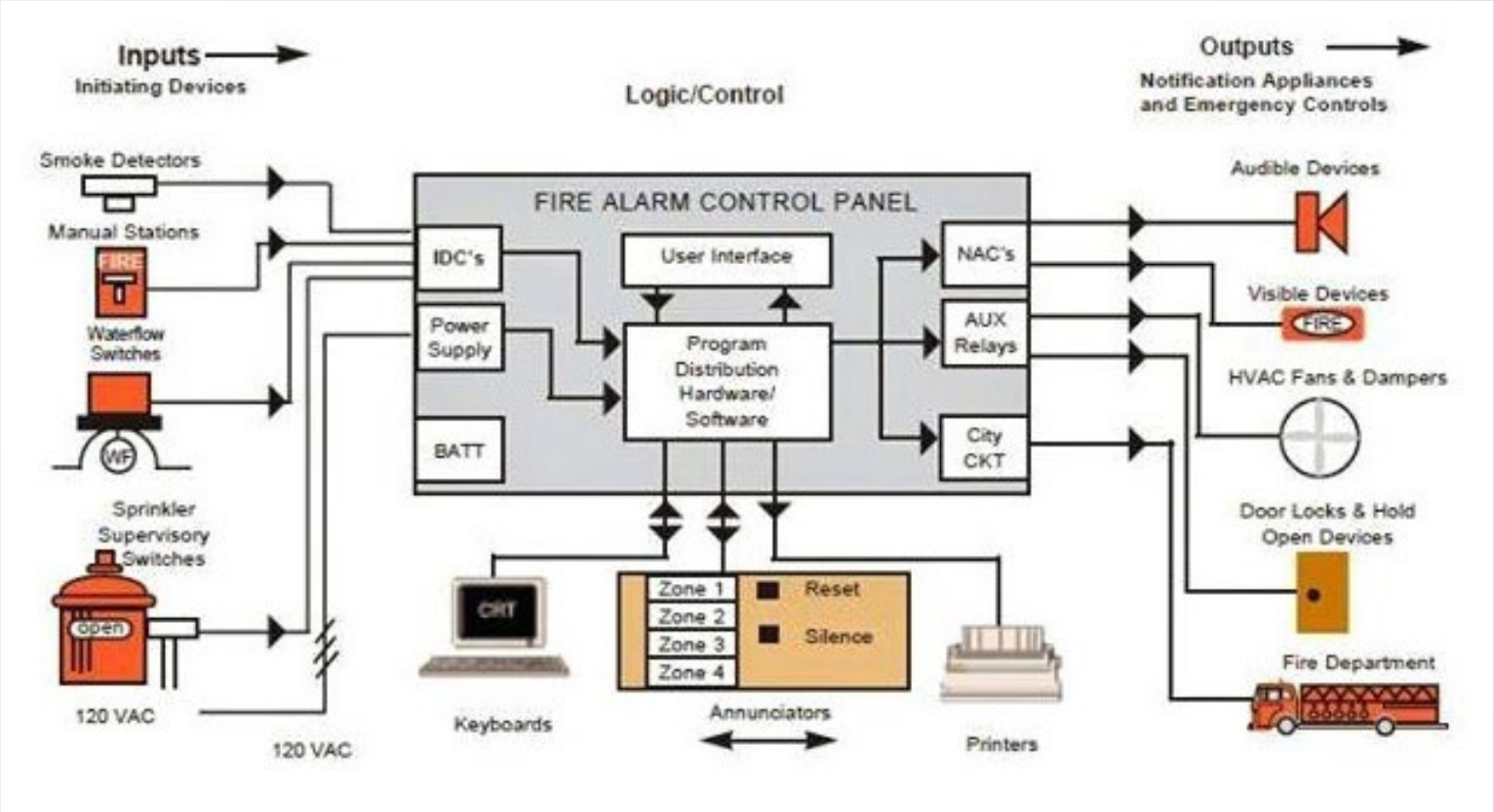
Type of Occupancy	Automatic Fire Suppression System	Standpipe System	Fire Detection Alarm and Communication System		Portable Fire Extinguisher
			Manual	Automatic	
e. Single and Two Family Dwellings	Not Required	Not Required	Single –station smoke or heat detector	Not Required	Required
ASSEMBLY	1. Assembly occupancies with occupant load of 150 or more a. Bars with live entertainment b. dance halls c. Discotheques d. Assembly occupancy with festival seating 2. Buildings containing assembly occupancies with occupant load of more than 300 persons	Occupant load exceeding 1000 persons	All assembly occupancy	Occupant load exceeding 300	Required
HEALTH CARE FACILITIES	All hospitals except one storey building with bed capacity not exceeding 5	4 or more storey in height	Not Required	Every building	Required
INDUSTRIAL	Every high hazard occupancy	4 or more storey in height	Less than 25 occupants	Occupant load exceeding 25	Required

Classification of Occupancy (Division 8 through 20) (Continuation)

Type of Occupancy	Automatic Fire Suppression System	Standpipe System	Fire Detection Alarm and Communication System		Portable Fire Extinguisher
			Manual	Automatic	
BUSINESS	Buildings with 15 meters or more in height	a. 4 or more storey in height b. Exceeds 1,860sq.m. per floor	a. one storey in height b. less than 50 occupants (for new buildings) and less than 100 occupants (for existing buildings) above and below the level of exit discharge c. less than 300 occupants (for new buildings) and less than 1000 occupants (for existing buildings)	a. 2 or more storeys in height b. 50 or more occupants (for new buildings) and 100 or more occupants (for existing buildings) above and below the level of exit discharge c. 300 or more occupants (for new buildings) and 1000 or more occupants (for existing buildings)	Required
RESIDENTIAL					
a. Hotel	4 storeys below NFPA 13R; 5 storeys above NFPA 13	4 or more storeys in height	Less than 15 occupants/ guests	15 or more occupants/ guests	Required
b. Dormitories	4 storeys below NFPA 13R; 5 storeys above NFPA 13	4 or more storeys in height	Less than 15 occupants/ guests	15 or more occupants/ guests	Required
c. Apartment Buildings	4 storeys below NFPA 13R; 5 storeys above NFPA 13	a. 4 or more storeys in height	Not more than 3 storeys in height	4 storeys or more in height, or more than 12 apartment units	Required
d. Lodging/ Rooming Houses	Not required	Not required	Single –station smoke or heat detector	Not Required	Required

Fire Detection & Alarm System Components

- Fire Alarm Control Panel / Unit
- Initiating Devices
- Notification Appliances
- Emergency Control Functions
- Supplementary Equipment



Fire Alarm Control Panel / Unit (FACP / FACU)

NFPA 72 - 2022

3.3.115 A component of the fire alarm system that receives signals from initiating devices or other fire alarm control units and processes these signals to determine part or all of the required fire alarm system output function(s).

10.3.5 Equipment shall be designed so that it is capable of performing its intended functions under the following conditions:
(1) At 85 percent and at 110 percent of the nameplate primary (main) and secondary (standby) input voltage(s)
(2) At ambient temperatures of 32°F (0°C) and 120°F (49°C)
(3) At a relative humidity of 85 percent and an ambient temperature of 86°F (30°C)

Fire Alarm Control Unit Location

NFPA 72 does not provide any requirements as to where the fire alarm control unit needs to be located. It simply states that it must be installed in accordance with the plans, specifications, and standards approved by the AHJ.

NFPA 72 - 2022

10.4.1 All systems shall be installed in accordance with the plans, specifications, and standards approved by the authority having jurisdiction.

RA 9514 - Revised IRR - 2019

SECTION 10.2.6.6 FIRE DETECTION, ALARM, AND COMMUNICATION SYSTEMS

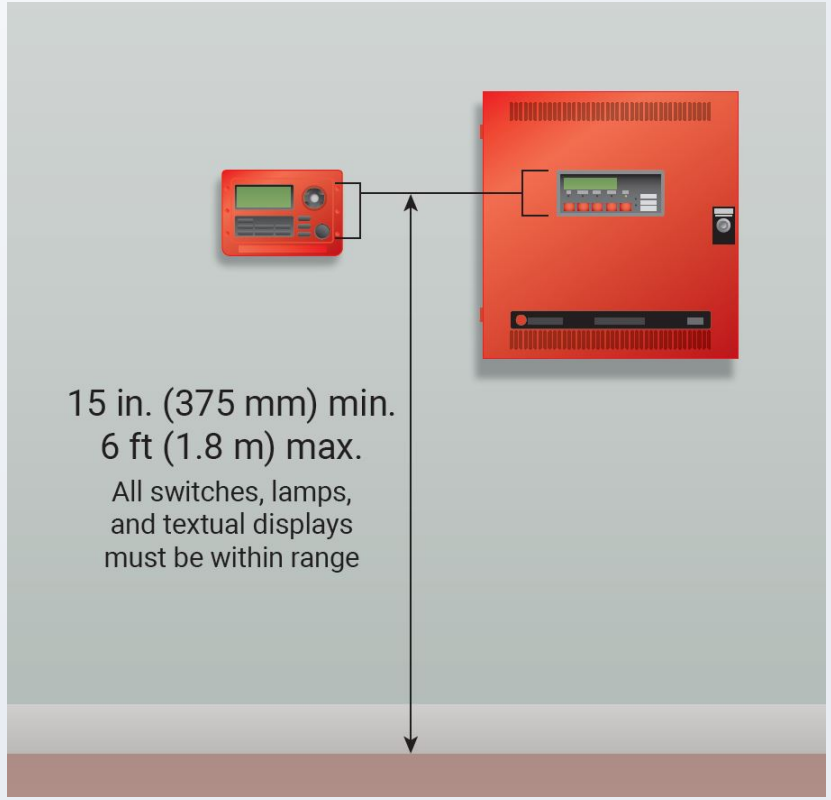
*G. **Location of Controls***

Operator controls, alarm indicators, and manual communications capability shall be installed in a control center at a convenient location acceptable to the C/MFM (City/Municipal Fire Marshal) having jurisdiction.

Control Panel Mounting

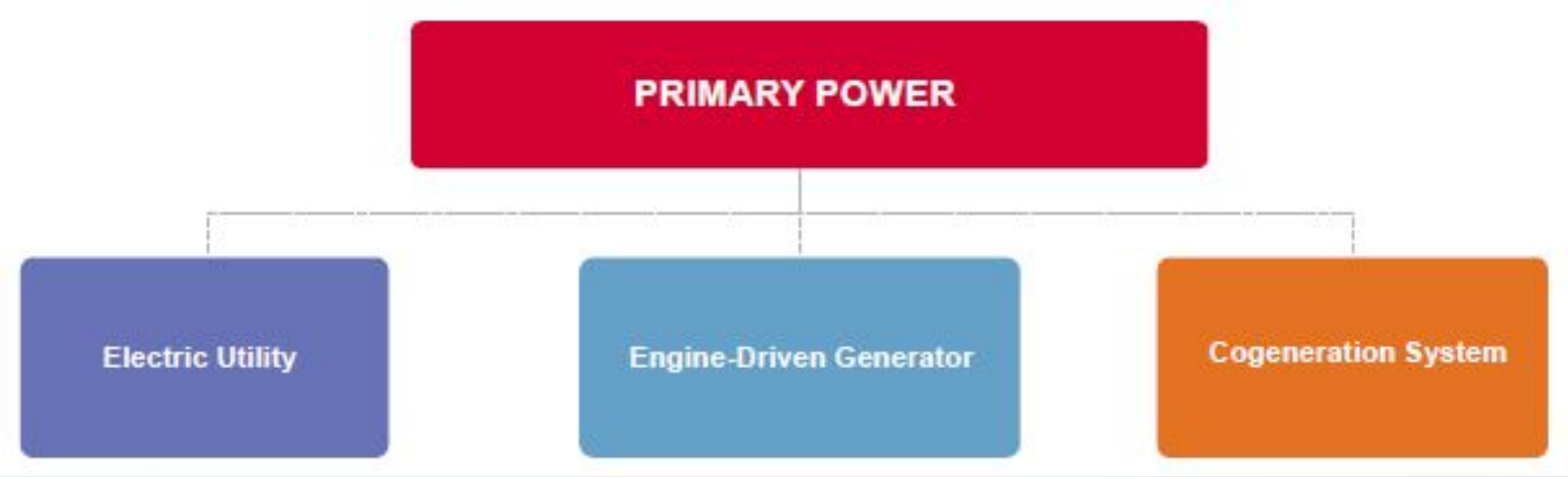
NFPA 72 - 2022

10.4.4 Unless otherwise permitted by the authority having jurisdiction, control unit displays, visible indicators, or controls shall be mounted such that the distance to the highest switch, lamp, or textual display does not exceed **6 ft. (1.8 m)** above the finished floor, and the lowest switch, lamp, or textual display shall not be less than **15 in. (375 mm)** above the finished floor.



Primary Power Supply

NFPA 72 - 2022
10.6.5.1.1
The branch circuit supplying the equipment shall be supplied by one of the following:
(1) Electric utility
(2) An engine-driven generator or equivalent in accordance with 10.6.11.2, where a person trained in its operation is on duty at all times
(3) An engine-driven generator or equivalent arranged for cogeneration with an electric utility in accordance with 10.6.11.2, where a person trained in its operation is on duty at all times



Primary Power Supply (Continuation)

NFPA 72 - 2022

10.6.5.1.2 The branch circuit supplying the equipment shall supply **no other loads**.

10.6.5.2.2 The system circuit disconnecting means shall be marked to identify the system or equipment that it serves.

10.6.5.2.3 For fire alarm and/or signaling systems, the circuit disconnecting means shall have a **red marking**.

10.6.5.4 **Circuit Breaker Lock**. Where a circuit breaker is the disconnecting means, an approved breaker locking device shall be installed.

Secondary Power Supply

Batteries *are common way to provide a secondary power supply, the most common type of battery is a valve-regulated lead-acid battery and they are typically located within the fire alarm control unit enclosure, or in a separate battery box located near the fire alarm control unit.*

Batteries

Battery Cabinet

Secondary Power Supply
NFPA 72 - 2022

10.6.7.2.1
The secondary power supply for the protected premises system shall have sufficient capacity to operate the system under quiescent load (system operating in a nonalarm condition) for a minimum of **24 hours**.

10.6.7.2.2
At the end of the period in 10.6.7.2.1, the secondary power supply shall be capable of operating all alarm notification appliances used for evacuation or to direct aid to the location of an emergency for **5 minutes**, unless otherwise permitted or required by 10.6.7.2.4.

10.6.7.2.3
The secondary power supply for **in-building fire emergency voice/alarm communications service** shall be capable of operating the system under quiescent load for a minimum of **24 hours**.

10.6.7.2.4
At the end of the period in 10.6.7.2.3, the secondary power supply shall be capable of operating the system during a fire or other emergency condition for a period of **15 minutes** at maximum connected load.

Engine-driven generators are also permitted as secondary power supplies but must be automatic starting. Additionally, the control panel must have sufficient batteries to provide **4 hours of standby time** (in case the generator does not start automatically) as per NFPA 72 - 2022 section 10.6.7.3.1 (2).

Battery Calculations Additional Safety Factor

- **20%** as per NFPA 72 - 2019 edition section 10.6.7.2.1.1 and other previous editions.
- **25%** as per NFPA 72 - 2022 edition section 10.6.7.2.14.

Battery Charging

NFPA 72 - 2022

10.6.10.3.2 Battery charging equipment shall be provided to recharge batteries within **48 hours** after fully charged batteries have been subject to a single discharge cycle.

Initiating Device

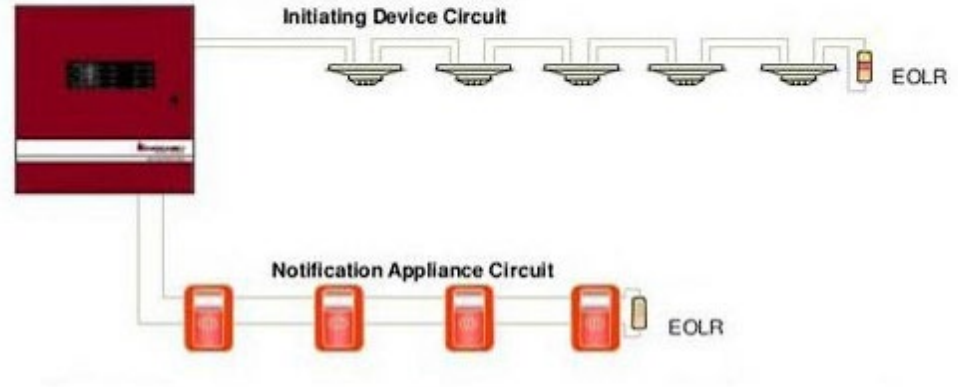
- **Automatic** – *A device designed to detect the presence of a fire signature.*
- **Manual** – *A device that requires the attention of a person to activate a fire alarm signal.*

NFPA 72 - 2022

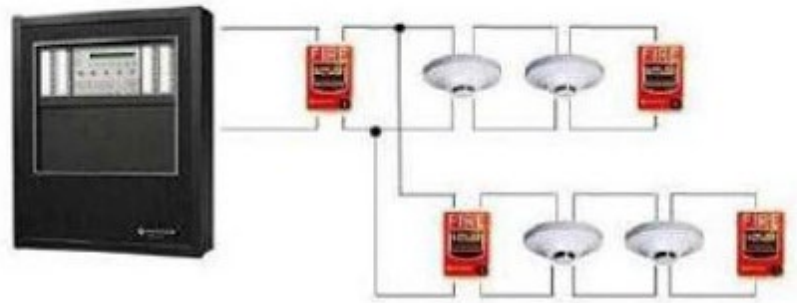
3.3.149 **Initiating Device Circuit** - ***Conventional*** **(IDC)**. A circuit to which automatic or manual initiating devices are connected where the signal received does not identify the individual device operated.

3.3.274 **Signaling Line Circuit** - ***Addressable*** **(SLC)**. A circuit path between any combination of addressable appliances or devices, circuit interfaces, control units, or transmitters over which multiple system input signals or output signals or both are carried.

Example of Initiating Device Circuit and Notification Device Circuit:

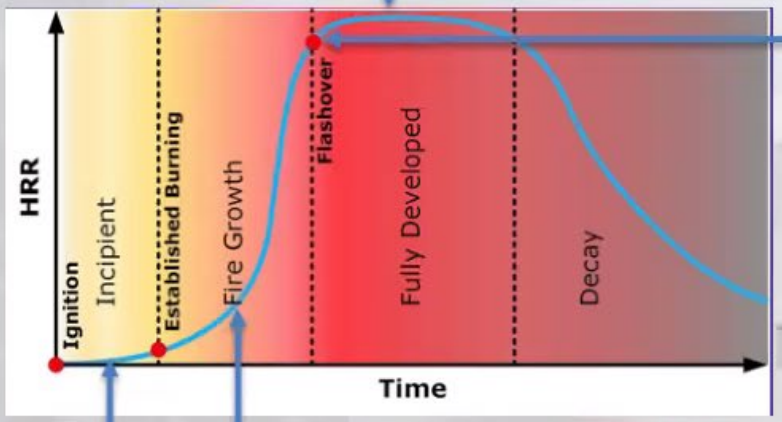


Example of Signaling Line Circuit:



Fire Detection Principles

Stages of a Fire



Flashover- Near-simultaneous ignition of most of the directly exposed combustible material in an enclosed area

INCIPIENT

- Stage One
  - Incipient: Products of Combustion particles are produced (<0.3 microns). No visible smoke or detectable heat. May occur for milliseconds or days.

Aspirating Smoke Detection

SMOLDERING

- Stage Two
  - Smoldering: Visible smoke particles are produced (>0.3 microns). Little visible flame or noticeable heat.

Photoelectric Smoke Detection

Duct Smoke Detection

Photoelectric Beam Smoke Detection

FLAME

- Stage Three
  - Flame: Rapid combustion produces radiant energy in the visible, and invisible (IR, UV) spectrums. Heat begins to buildup at this stage

UV/IR Flame Detection

HIGH HEAT

- Stage Four
  - High Heat: Uncontrolled combustion is caused by the heating of nearby combustibles to their ignition point.
  - Note! Major disadvantages of using thermal energy for fire identification are
    - Takes a while for a fire to be recognized
    - The toxic gases that are produced before an alarm point is reached

Fixed Temp/ROR

Linear Heat Detection

Waterflow Detection

Sprinkler Activation

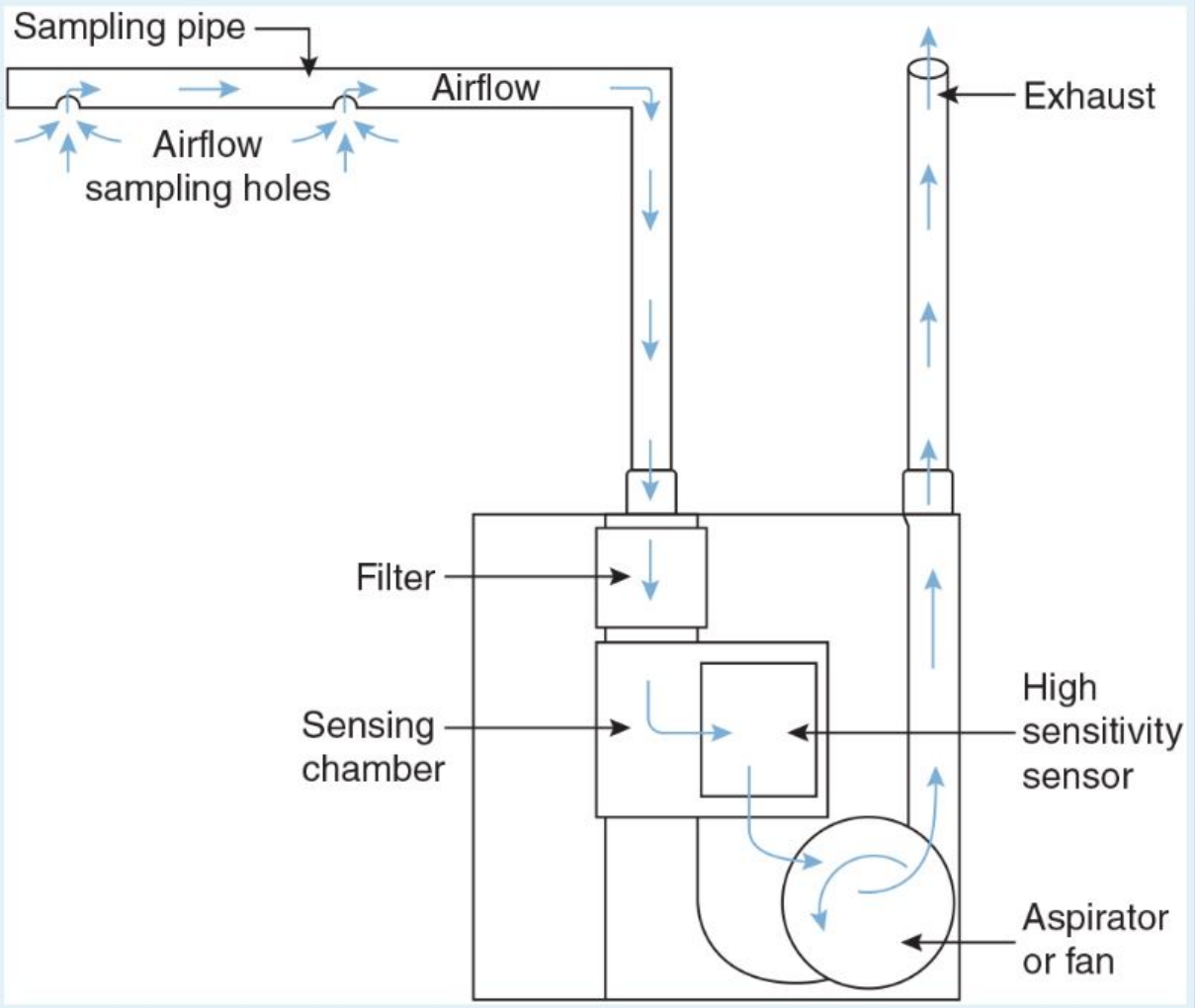
AUTOMATIC FIRE DETECTION

Air Sampling – Type Detector

NFPA 72 - 2022

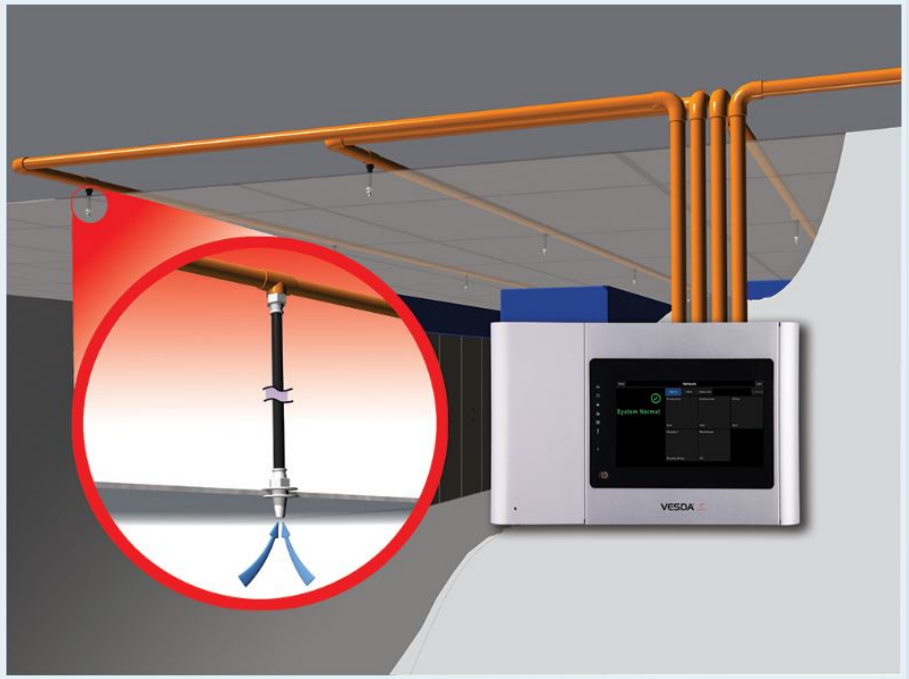
3.3.77.1 **Air Sampling-Type Detector**

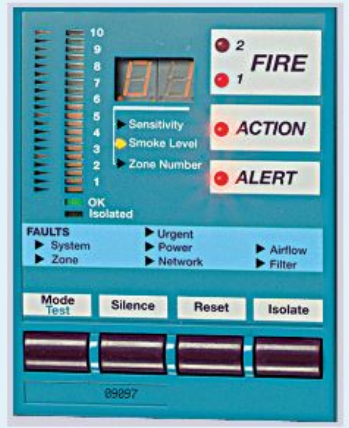
A detector that draws air and particulate from the protected area into a sampling network that runs to the detector. An aspiration fan in the detector housing draws air from the protected area back to the detector through air sampling ports, piping, or tubing. At the detector, the air is analyzed for fire products.



Some Applications of Air Sampling – Type Detector (Refer to Manufacturer)

- *Accommodation (Apartments, Hotels, Shops and Offices)*
- *Correctional Facilities*
- *Clean Rooms*
- *Cold Storage*
- *Cultural/Heritage*
- *Data & Telecom*
- *Hospitals and Healthcare*
- *Insurance*
- *Marine*
- *Nuclear Facilities*
- *Oil & Gas*
- *Portable Switch Rooms*
- *Power Generation*
- *Records Storage*
- *Transportation*
- *Wind Power Generation*
- *Warehousing*





Air Sampling – Type Detector Spacing

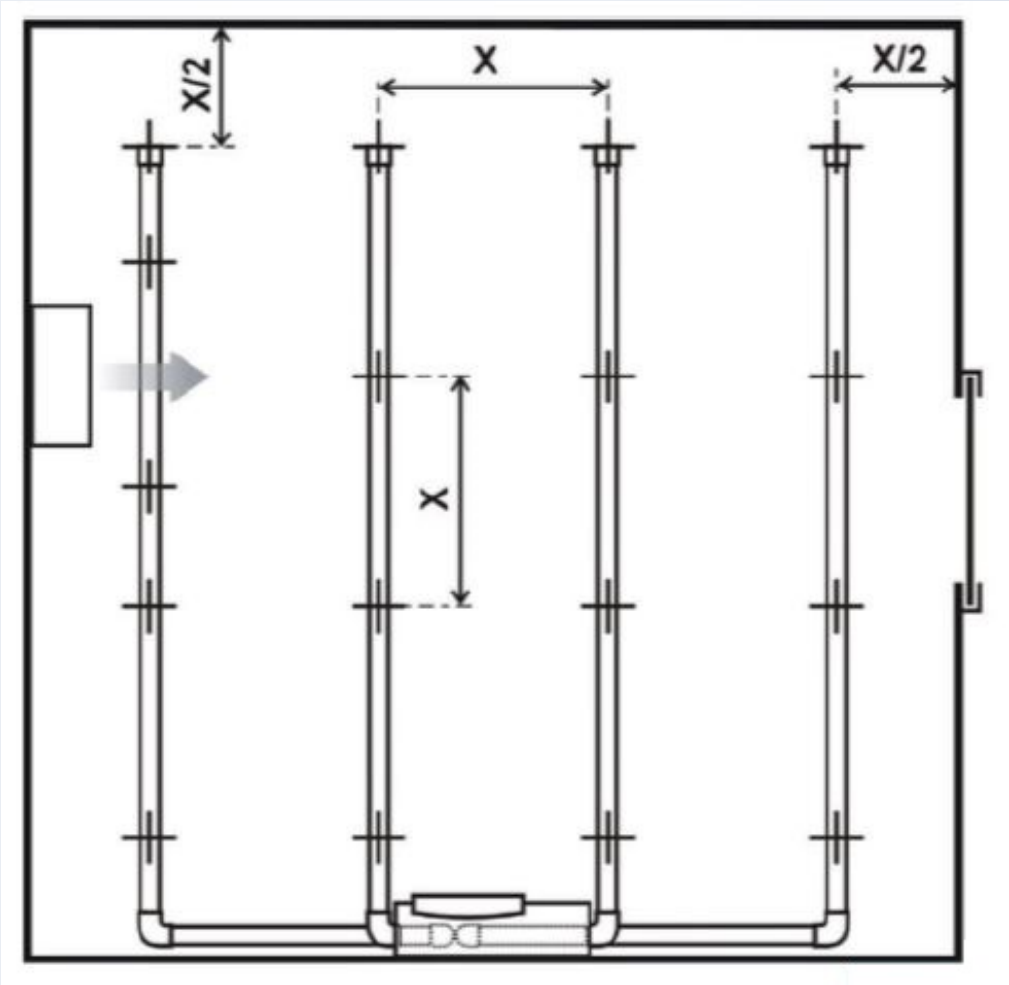
NFPA 72 - 2022

17.7.4.6.1.1 In the absence of specific performance-based design criteria, each sampling port of an air sampling–type smoke detector shall be treated as a spot-type smoke detector for the purpose of location and spacing in accordance with 17.7.4.

17.7.4.6.2.1 Maximum air sample transport time from the farthest sampling port to the detector shall not exceed **120 seconds**.

17.7.4.6.2.2 Sampling pipe networks shall be designed on the basis of, and shall be supported by, computer-based fluid dynamics design calculations to ensure required performance.

17.7.4.6.2.4 Software applications for the design of pipe networks shall be listed for use with the manufacturer's equipment.



Smoke Detector

NFPA 72 - 2022

3.3.77.21 **Smoke Detector**

A device that detects visible or invisible particles of combustion.

Photoelectric Smoke Detector

Smoke detector using the photoelectric light scattering principle are usually spot-type.

Duct Smoke Detector

This type of smoke detector detects smoke for the primary purpose of controlling the spread of smoke through the Heating Ventilating and Air Conditioning (HVAC) System.

Projected Beam - Type Smoke Detector

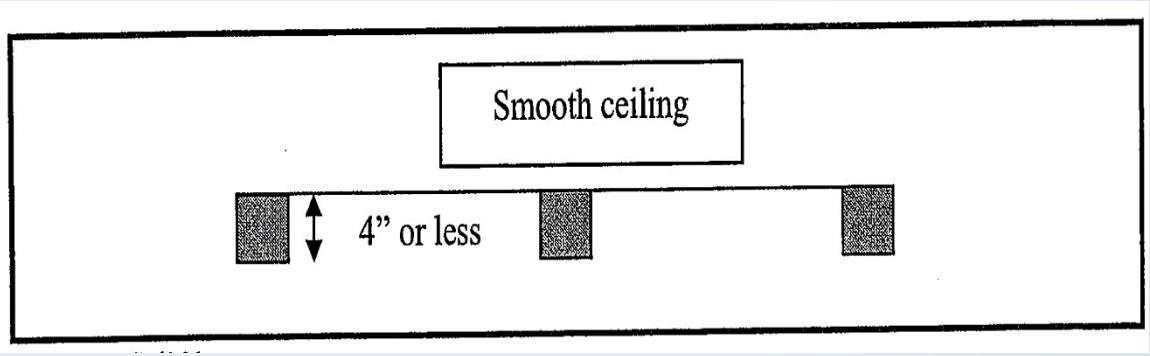
A type of photoelectric light obscuration smoke detector wherein the beam spans the protected area.

Smoke Detector Spacing

Is also affected by the shape of the ceiling surface.

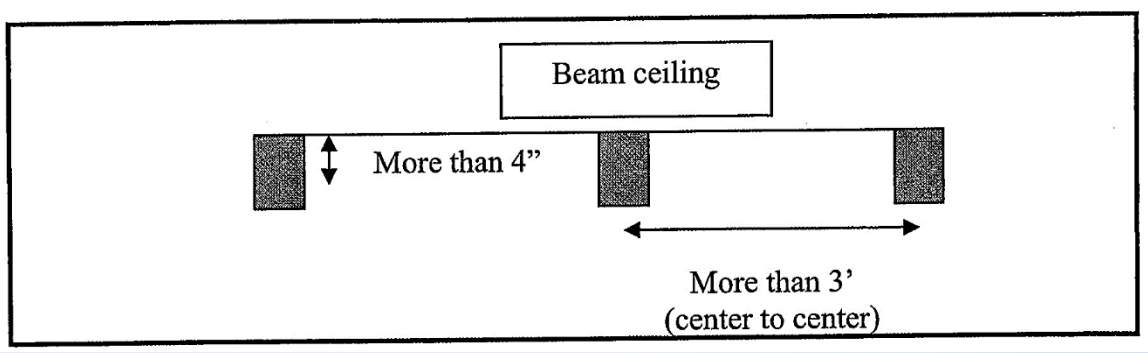
1.) Smooth Ceiling

A ceiling without any solid projections down from the surface not more than 4 inches high.



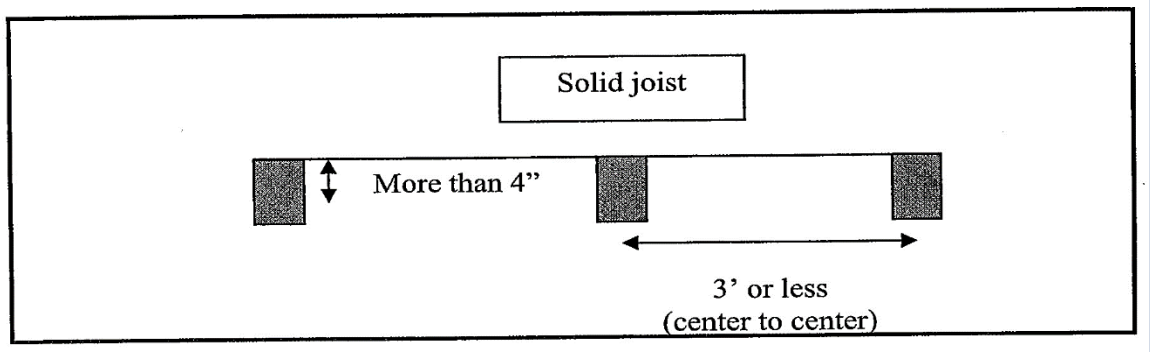
2.) Beam

Beam ceiling have a solid projections down from the surface more than 4 inches and more than 3 feet apart center to center.



3.) Solid Joist

Solid joist ceilings have solid projections down from the surface more than 4 inches and 3 feet or less apart center to center.

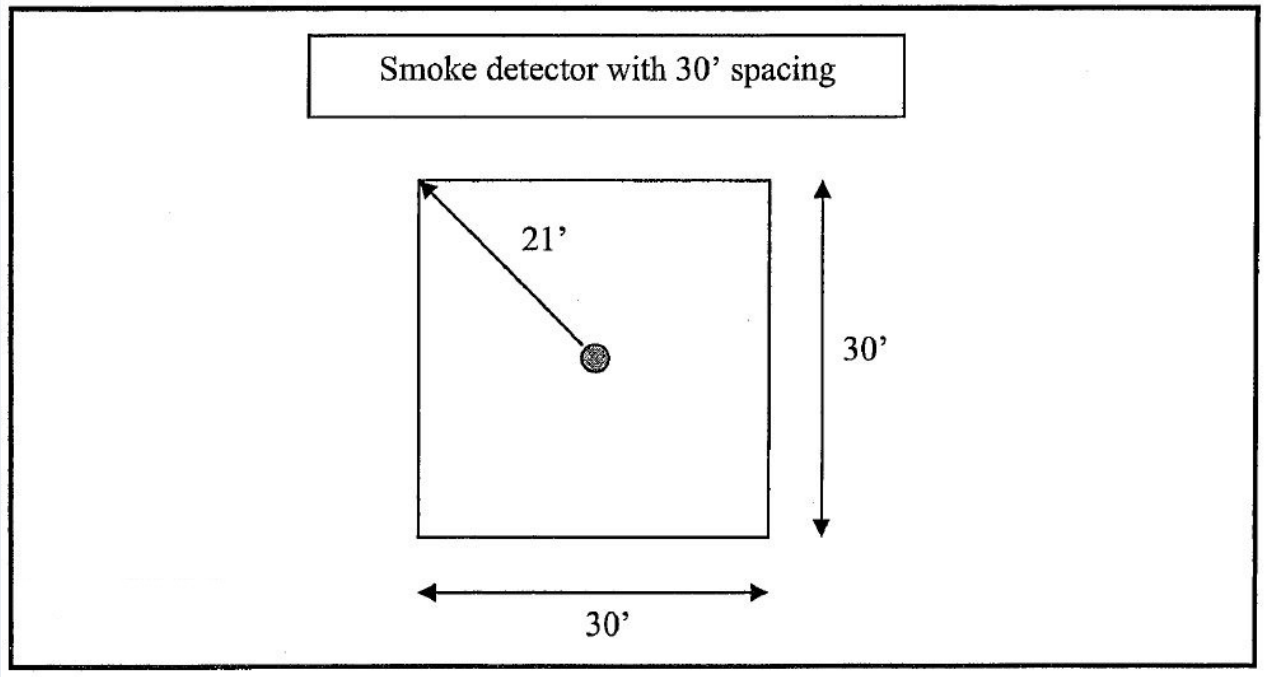


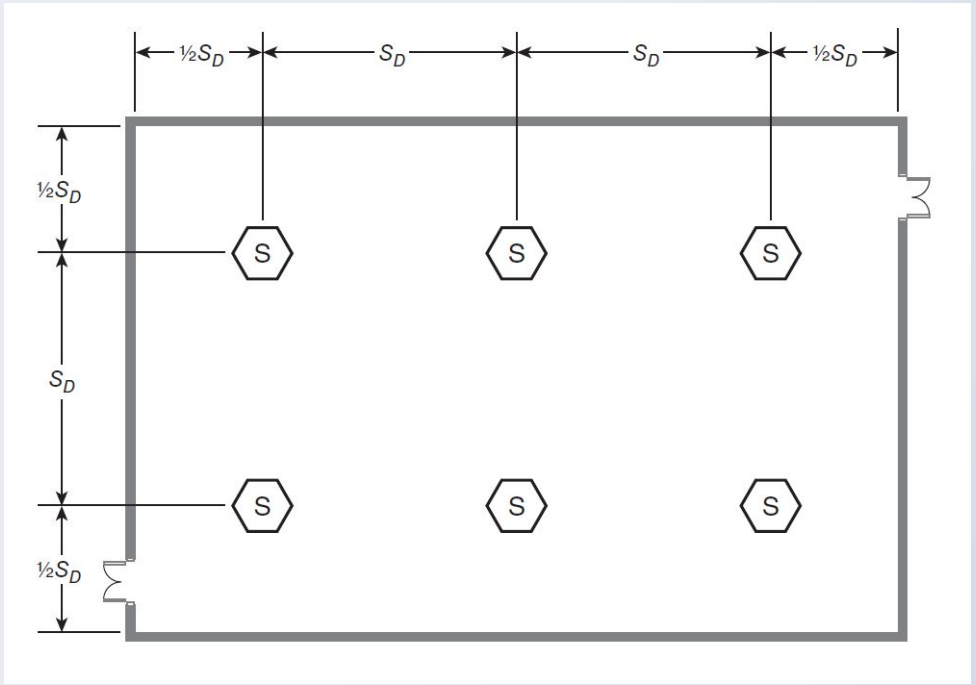
Smoke Detector Spacing (Continuation)

NFPA 72 - 2022

17.7.4.2.3.1 In the absence of specific performance-based design criteria, one of the following requirements shall apply:

(1) The distance between smoke detectors shall not exceed a nominal spacing of **30 ft. (9.1 m)** and there shall be detectors within a distance of one-half the nominal spacing, measured at right angles from all walls or partitions extending upward to within the top 15 percent of the ceiling height.

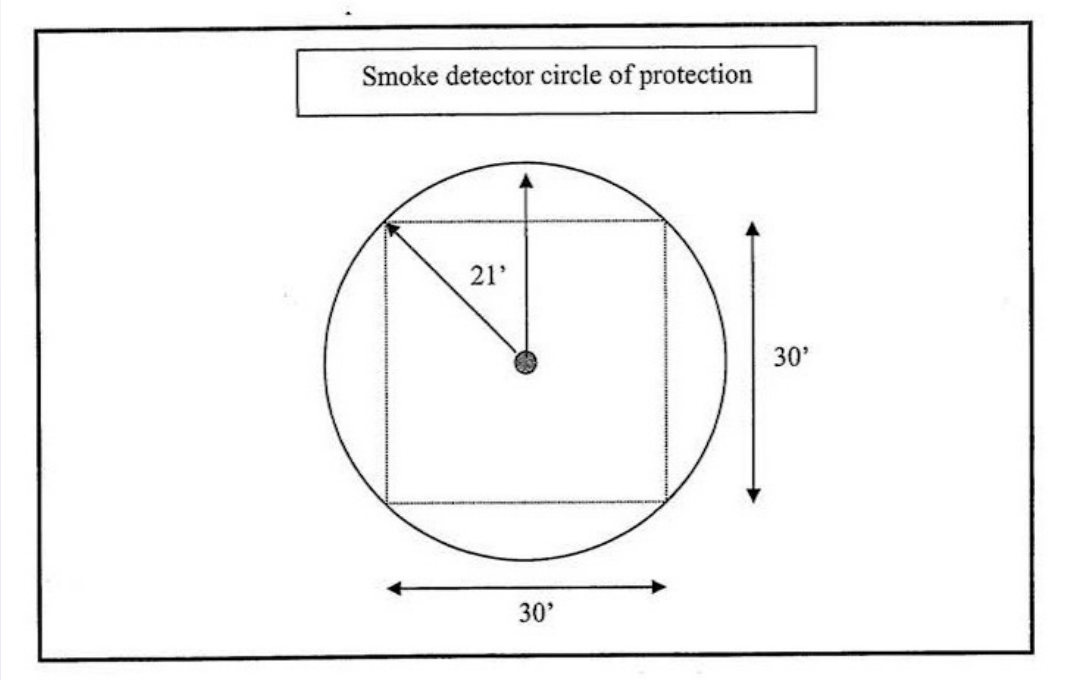


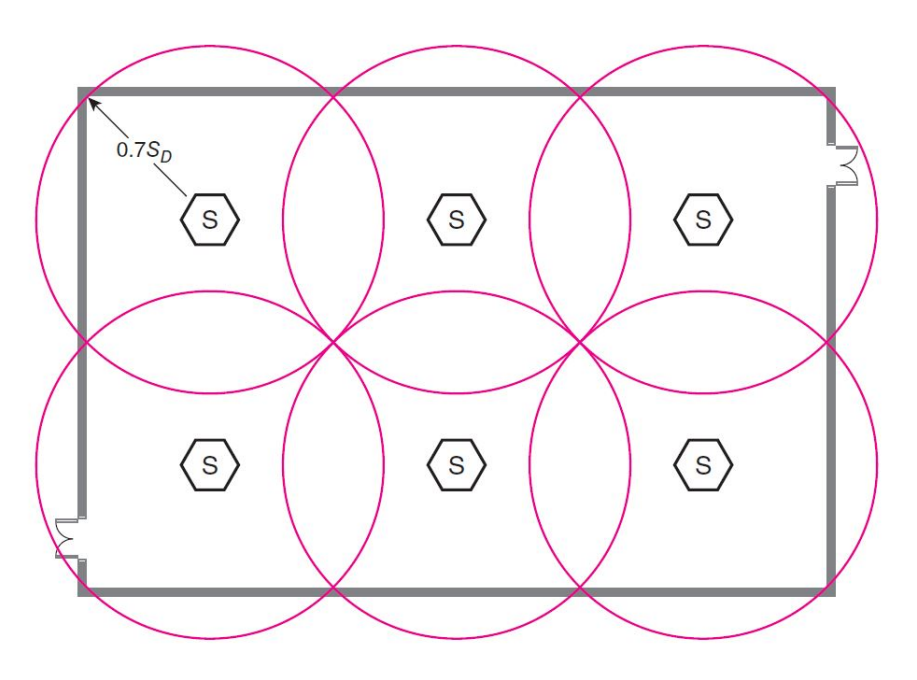


Smoke Detector Spacing (Continuation)

NFPA 72 - 2022 17.7.4.2.3.1 (Continuation)
(2) All points on the ceiling shall have a detector within a distance equal to or less than **0.7 times** the nominal 30 ft. (9.1 m) spacing (0.7*S*).

** NFPA 72 recognizes that a smoke detector can therefore protect areas as much as 21 feet away. So the area of protection is actually a circle which encompasses all points within 21 feet of the smoke detector.*

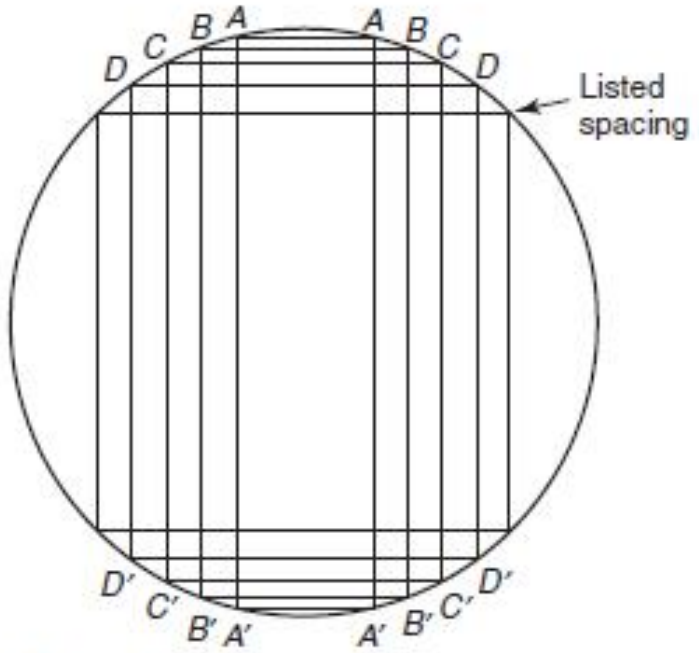




Smoke Detector Spacing (Continuation)

*The **0.7 Rule** has practical application in corridors because corridor is narrow. NFPA 72 permits extended spacing of automatic detectors. Here are some typical examples of the extended spacing allowed by code for smoke detectors:*

- *10 ft wide corridor, extended spacing is 41 ft.*
- *15 ft wide corridor, extended spacing is 39 ft.*
- *20 ft wide corridor, extended spacing is 37 ft.*
- *25 ft wide corridor, extended spacing is 34 ft.*



Rectangles

A = 10 ft × 41 ft = 410 ft^2 (3.1 m × 12.5 m = 38 m^2)
B = 15 ft × 39 ft = 585 ft^2 (4.6 m × 11.9 m = 54 m^2)
C = 20 ft × 37 ft = 740 ft^2 (6.1 m × 11.3 m = 69 m^2)
D = 25 ft × 34 ft = 850 ft^2 (7.6 m × 10.4 m = 79 m^2)

Listed spacing for heat detectors only = 30 ft × 30 ft = 900 ft^2 (9.1 m × 9.1 m = 84 m^2)

Note: Smoke detectors are not listed for spacing. Use manufacturer's coverage recommendations and this figure.

FIGURE A.17.6.3.1.1(g) Detector Spacing, Rectangular Areas.

Smoke Detector Spacing (Continuation)

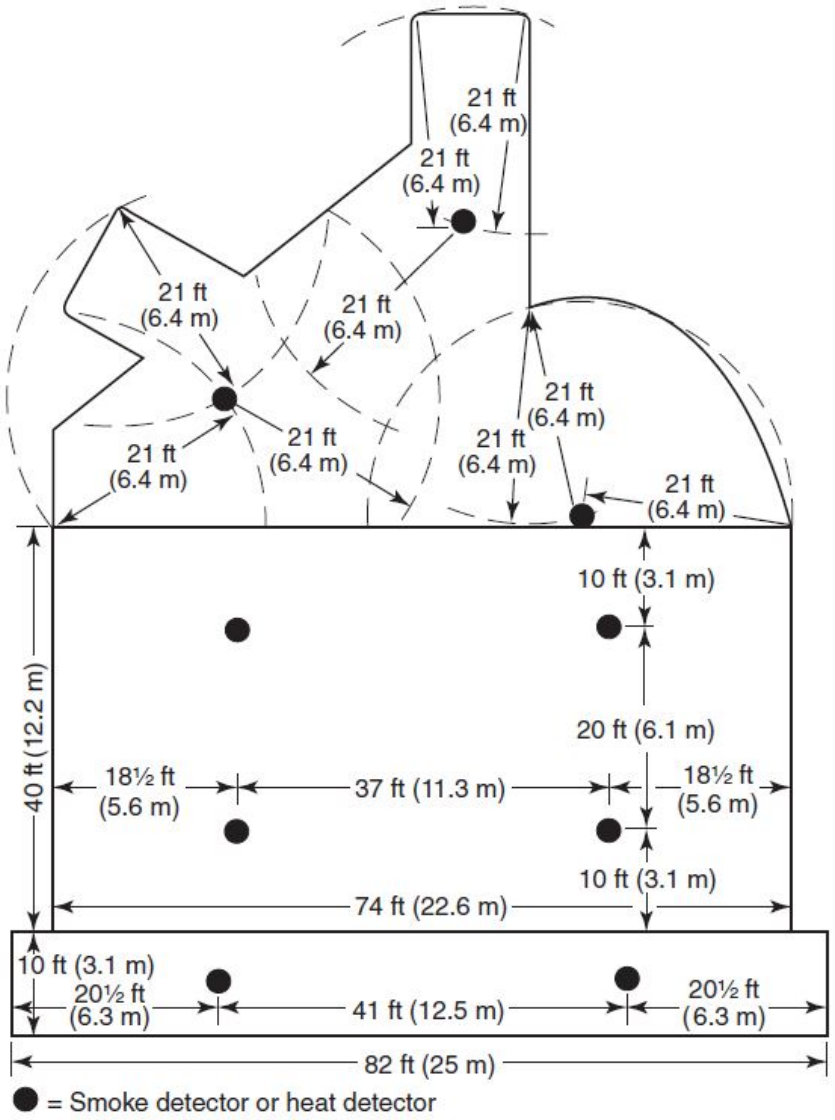

21 ft (6.4 m)
21 ft (6.4 m)
21 ft (6.4 m)
21 ft (6.4 m)
21 ft (6.4 m)
21 ft (6.4 m)
21 ft (6.4 m)
21 ft (6.4 m)
21 ft (6.4 m)
10 ft (3.1 m)
20 ft (6.1 m)
10 ft (3.1 m)
40 ft (12.2 m)
18½ ft (5.6 m)
37 ft (11.3 m)
18½ ft (5.6 m)
74 ft (22.6 m)
10 ft (3.1 m)
20½ ft (6.3 m)
41 ft (12.5 m)
20½ ft (6.3 m)
82 ft (25 m)
= Smoke detector or heat detector

FIGURE A.17.6.3.1.1(h) Smoke or Heat Detector Spacing Layout in Irregular Areas.

Philippines Electronics Code Book 2 on FDAS

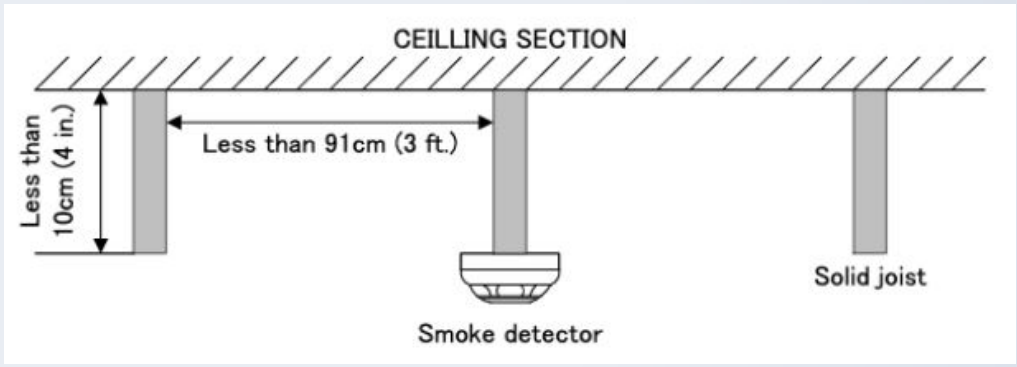
*2.5.4.6 For flat ceilings with a height of not more than **4 meters**,*
*(1) Smoke detector spacing shall not be more than **9 meters**. Therefore, all points on the ceiling shall have a detector within a distance of **6.4 meters**.*

*2.5.4.7 For flat ceilings with a height of more than **4 meters** but not more than **6 meters**,*
*(1) Smoke detector spacing shall not be more than **4.5 meters**. Therefore, all points on the ceiling shall have a detector within a distance of **3.18 meters**.*

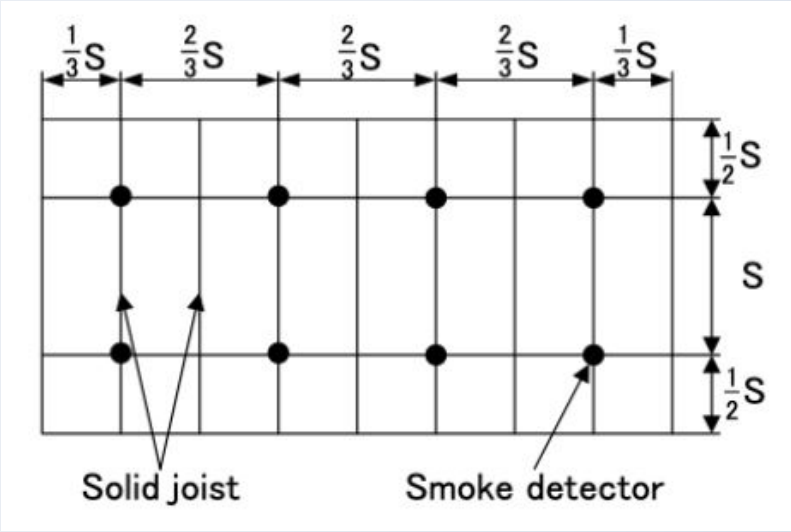
Spot-type Smoke Detector Placement at Solid Joist and Beams

NFPA 72 - 2022
17.7.4.2.4.1 Solid joists shall be considered equivalent to beams for smoke detector spacing guidelines.

*A **Solid Joist** is defined as greater than 4 in (10 cm) in depth and spaced less than 3 ft (91 cm) apart. Joists with less than 4 in. are considered flat ceilings. Smoke detector can be mounted on ceiling or on the bottom of joists.*



Smoke Detector Spacing for Solid Joist Construction (Elevation View)



Smoke Detector Spacing for Solid Joist Construction (Plan View)

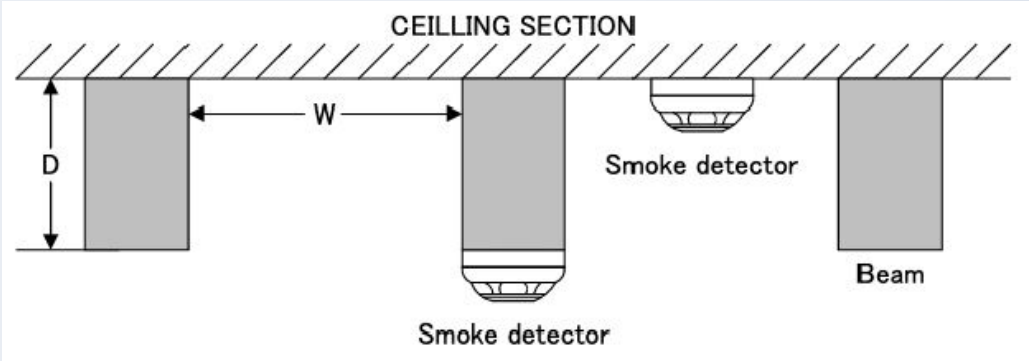
Spot-type Smoke Detector Placement at Solid Joist and Beams (Continuation)

Beams

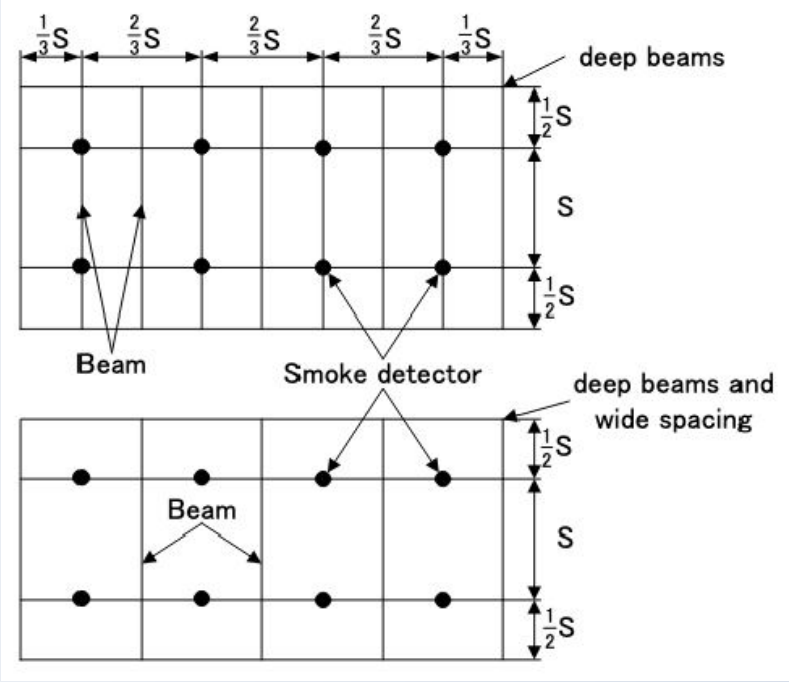
D/H > 0.1 and W/H > 0.4
Mount the smoke detector on the ceiling.

D/H < 0.1 or W/H < 0.4
Mount the smoke detector on the bottom of the beam.

Legend:
D = Beam Depth
H = Ceiling Height
W = Width between Beams



Smoke Detector Spacing for Beam Construction (Elevation View)



Smoke Detector Spacing for Beam Construction (Plan View)

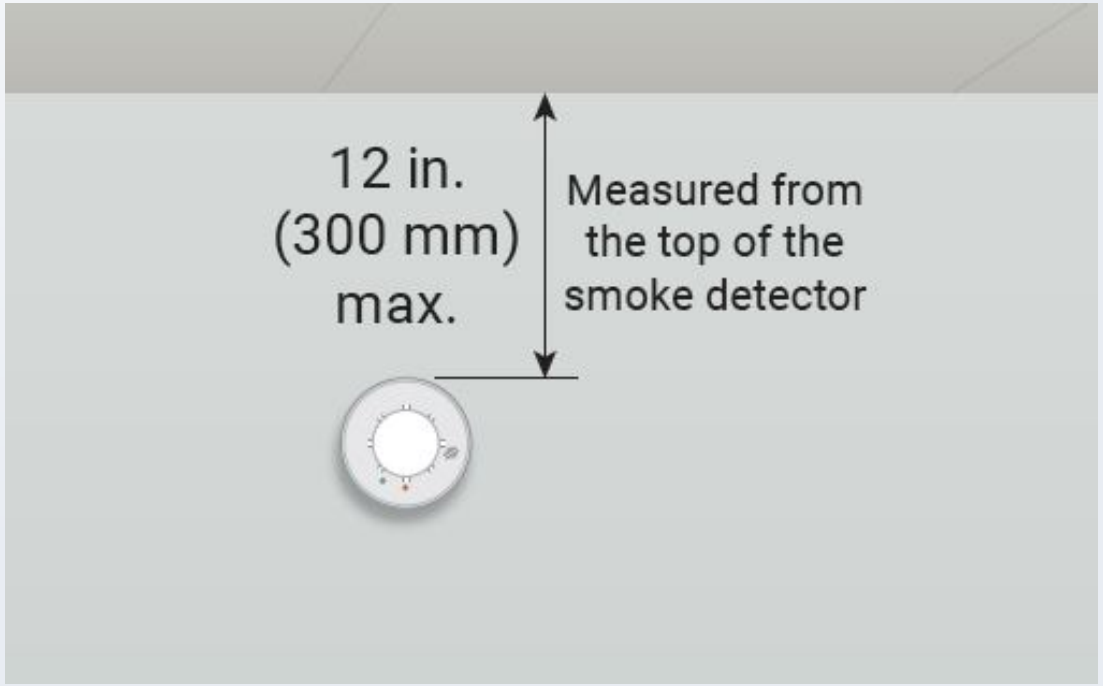
Spot-type Smoke Detector Installation Consideration

NFPA 72 - 2022

A.17.7.5.1 Detectors should not be located in a direct airflow or closer than **36 in. (910 mm)** from an air supply diffuser or return air opening. Supply or return sources larger than those commonly found in residential and small commercial establishments can require greater clearance to smoke detectors. Similarly, smoke detectors should be located farther away from high velocity air supplies.

Spot-type Smoke Detector
Installation Consideration (Continuation)

NFPA 72 - 2022
17.7.4.2.1
Spot-type smoke detectors shall be located on the ceiling or, if on a sidewall, between the ceiling and 12 in. (300 mm) down from the ceiling to the top of the detector.



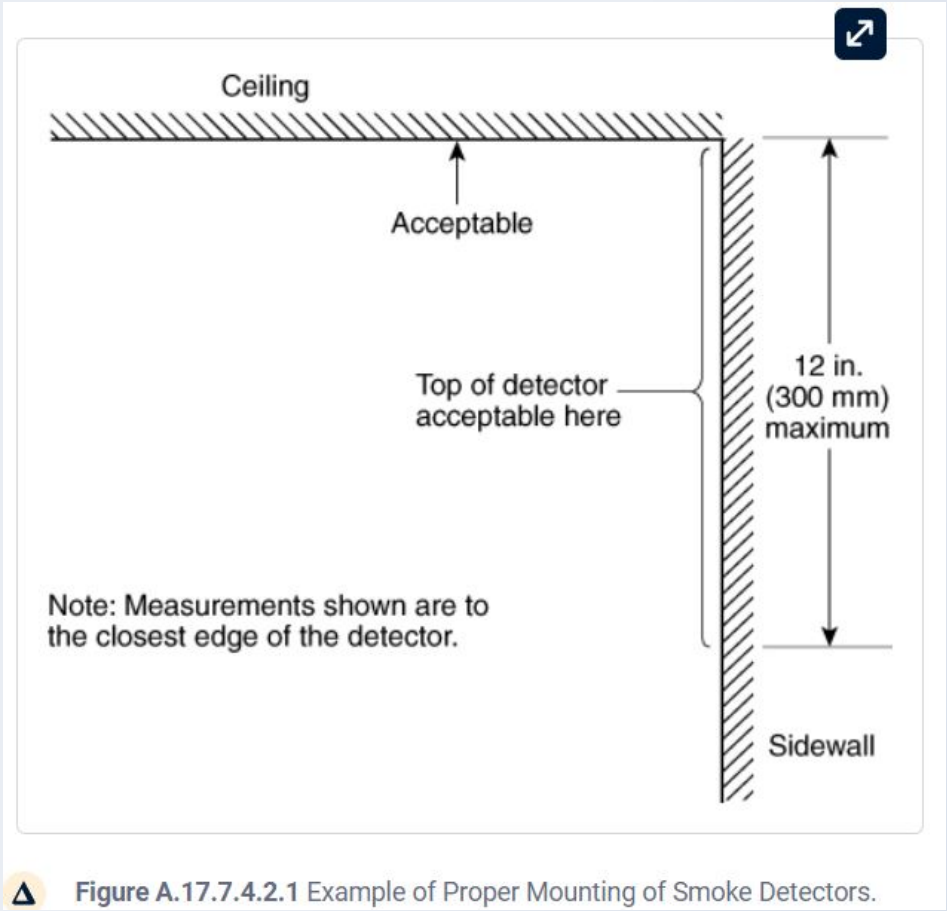
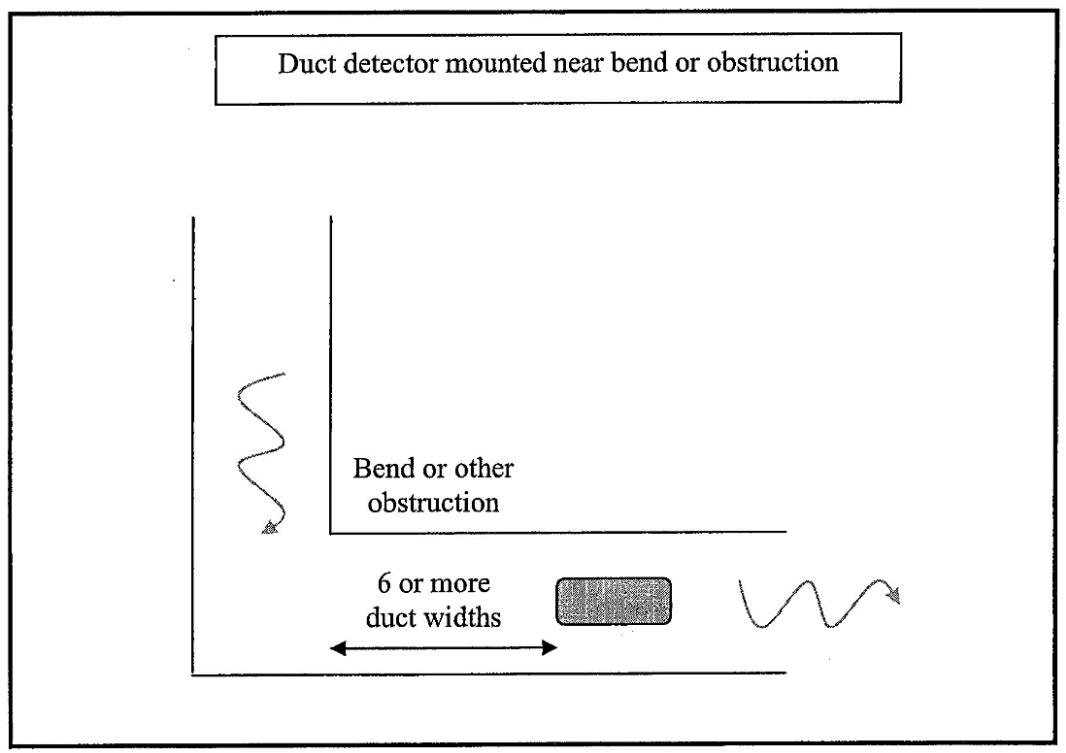
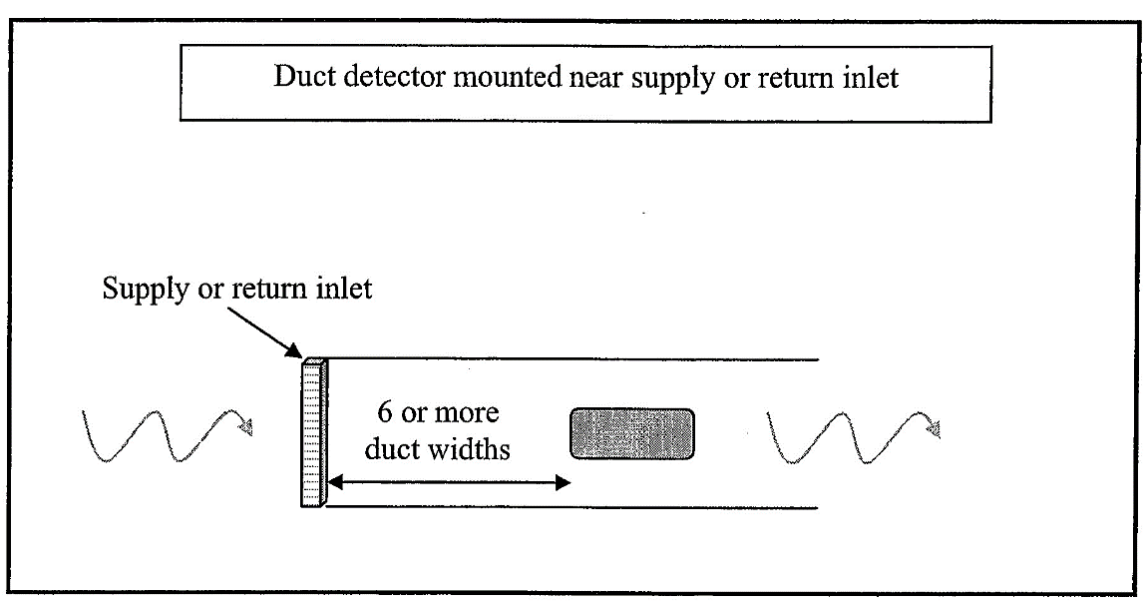


Figure A.17.7.4.2.1 Example of Proper Mounting of Smoke Detectors.

Duct Smoke Detector Placement





Sample Duct Smoke Detector Installation

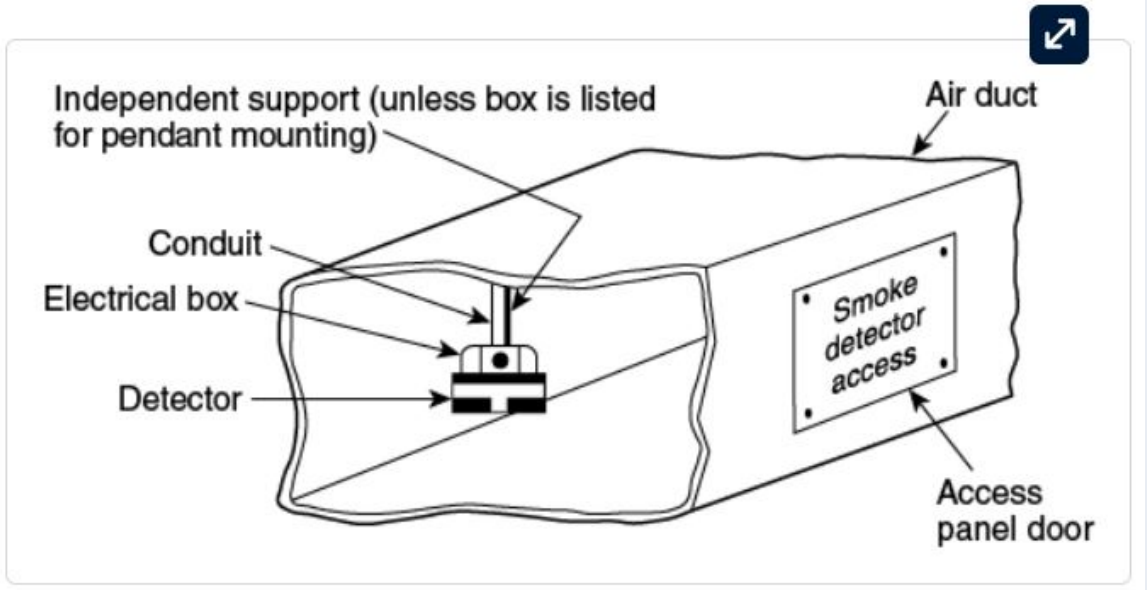


Figure A.17.7.6.5.2(a) Pendant-Mounted Air Duct Installation.

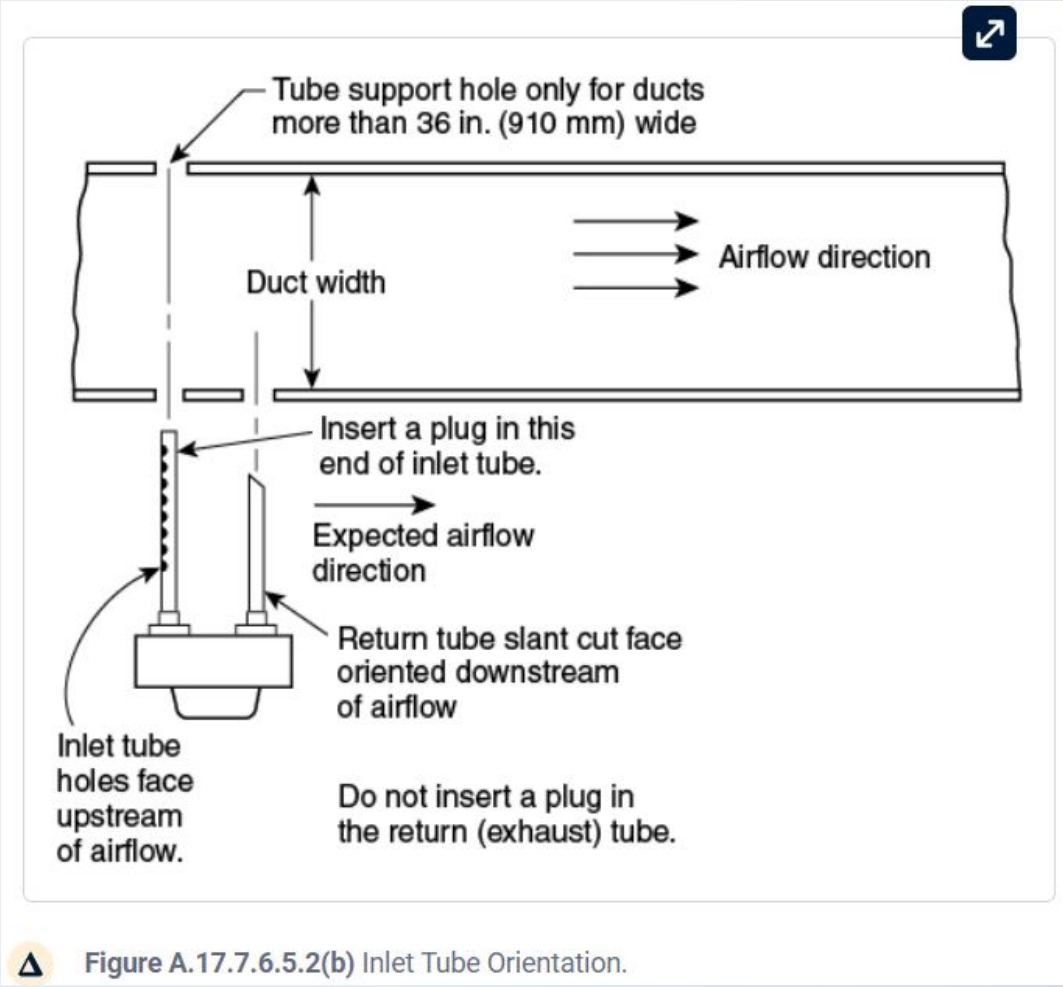

Tube support hole only for ducts more than 36 in. (910 mm) wide
Duct width
Airflow direction
Insert a plug in this end of inlet tube.
Expected airflow direction
Return tube slant cut face oriented downstream of airflow
Inlet tube holes face upstream of airflow.
Do not insert a plug in the return (exhaust) tube.

Figure A.17.7.6.5.2(b) Inlet Tube Orientation.

Projected Beam-Type Smoke Detector

**For ceilings with a height of more than 20 ft. (6 m), spot-type smoke detectors shall not be used. Instead, beam-type smoke detectors shall be used as per PELC Book 2 Clause 2.5.4.8.*

Some applications are manufacturing plants, warehouses, hangars, stables, airports, sport/leisure centers, conference/exhibition centers, shopping malls, atriums, mosque, museums, and historic buildings.

Point-to-Point Projected Beam Smoke Detector. (Source: Hochiki America Corp., Buena Park, CA)

Reflective Projected Beam Smoke Detector. (Source: Hochiki America Corp., Buena Park, CA)

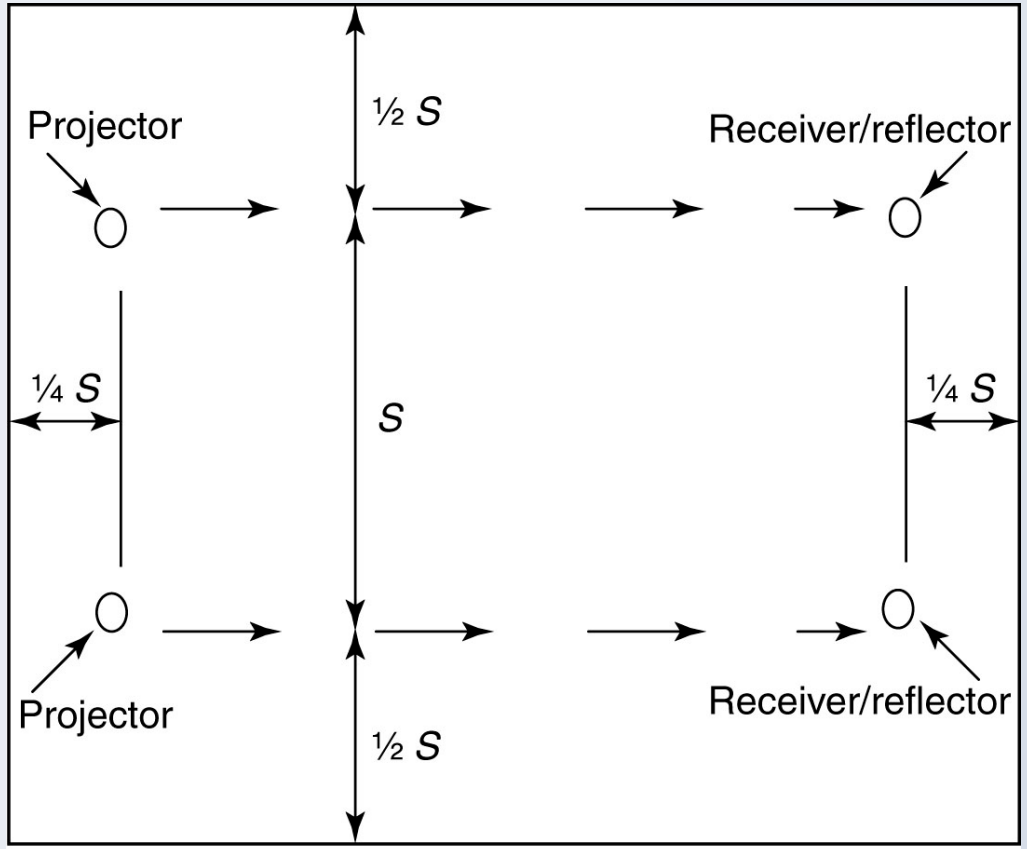
Projected Beam-Type Smoke Detector Spacing

NFPA 72 - 2022

A.17.7.4.7 On smooth ceilings, a spacing of not more than **60 ft. (18.3 m)** between projected beams and not more than one-half that spacing between a projected beam and a sidewall (i.e., wall parallel to the beam travel) should be used as a guide. Other spacing should be determined based on ceiling height, airflow characteristics, and response requirements.

In some cases, the light beam projector is mounted on one end wall, with the light beam receiver or reflector mounted on the opposite wall. However, it is also permitted to suspend the projector and receiver/reflector from the ceiling at a distance from the end walls not exceeding one-quarter the selected spacing (*S*).

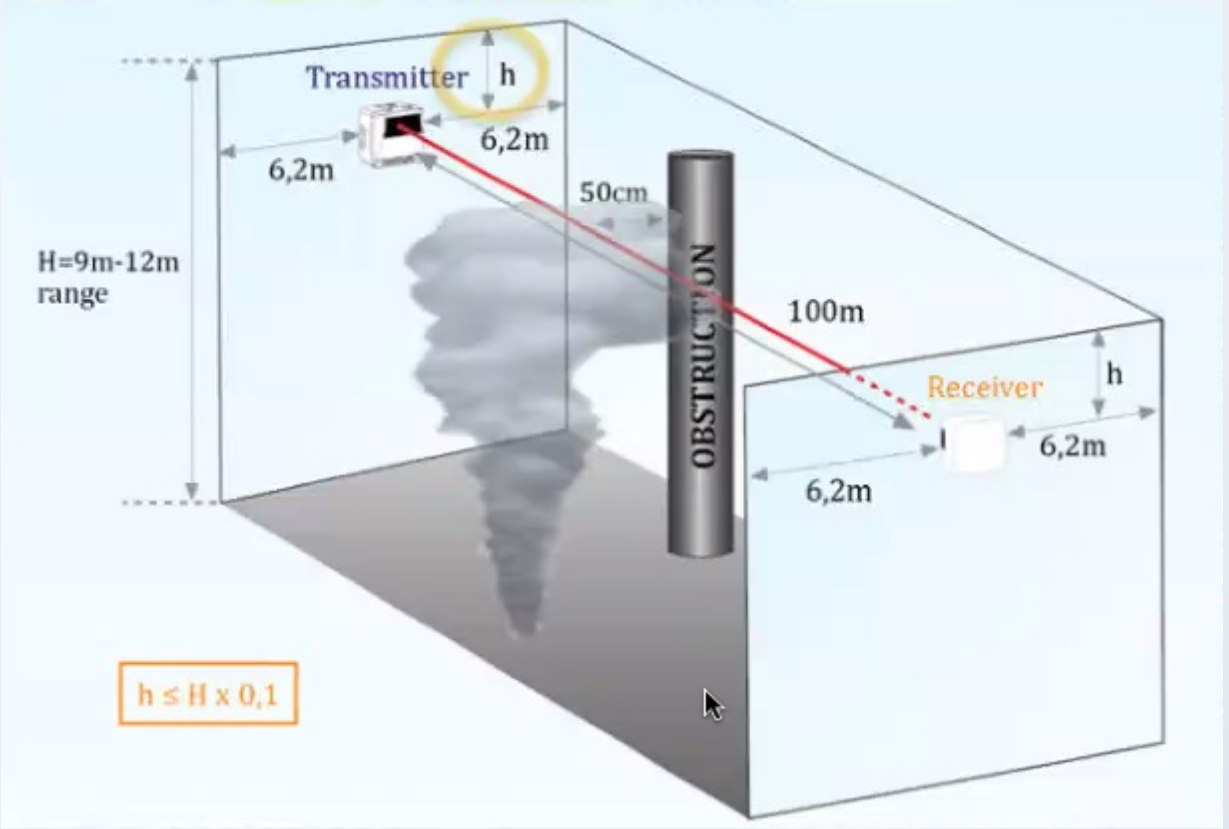
Figure A.17.7.4.7 Maximum Distance at Which Ceiling-Suspended Light Projector and Receiver/Reflector Can Be Positioned from End Wall Is One-Quarter Selected Spacing *(S)*.



Projected Beam-Type Smoke Detector Spacing (Continuation)

NFPA 72 - 2022
17.7.4.7.1 Projected beam–type smoke detectors shall be located in accordance with the manufacturer's published instructions.

To detect the smoke layer, the maximum distance from beam detector to the ceiling is 10% of the ceiling height.

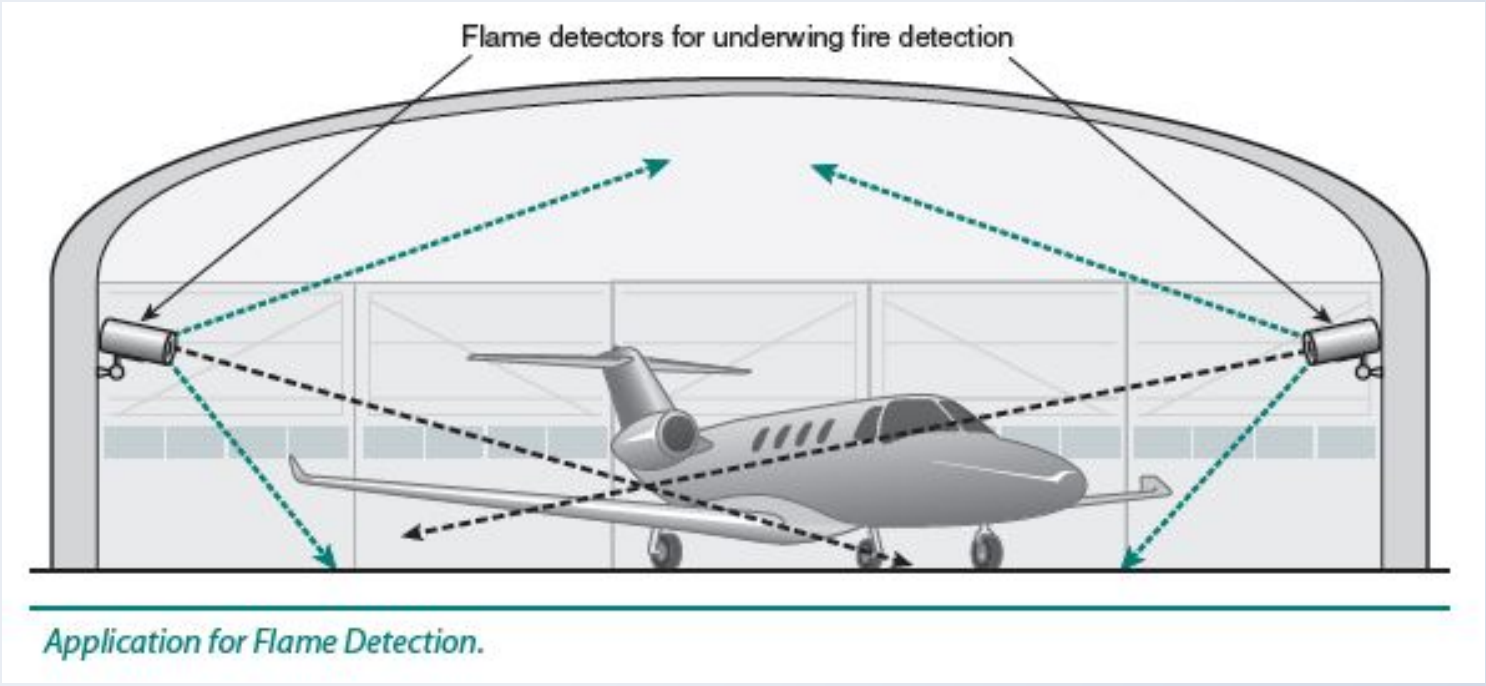


Flame Detector

NFPA 72 - 2022

3.3.77.9 **Flame Detector**
A **radiant energy - sensing fire detector** that detects the radiant energy emitted by a flame.

A.3.3.77.9 Flame Detector
Flame detectors are categorized as ultraviolet, single wavelength infrared, ultraviolet infrared, or multiple wavelength infrared.



Application for Flame Detection.

Flame Detector (Continuation)

NFPA 72 - 2022
17.8.3.2.1

The location and spacing of detectors shall be the result of an engineering evaluation that includes the following:

(1) Size of the fire that is to be detected

(2) Fuel involved

(3) Sensitivity of the detector

(4) Field of view of the detector

(5) Distance between the fire and the detector

(6) Radiant energy absorption of the atmosphere

(7) Presence of extraneous sources of radiant emissions

(8) Purpose of the detection system

(9) Response time required

A.17.8.3.2.1

The following are types of application for which flame detectors are suitable:

(1) High-ceiling, open-spaced buildings such as warehouses and aircraft hangars

(2) Outdoor or semi-outdoor areas where winds or drafts can prevent smoke from reaching a heat or smoke detector

(3) Areas where rapidly developing flaming fires can occur, such as aircraft hangars, petrochemical production areas, storage and transfer areas, natural gas installations, paint shops, or solvent areas

(4) Areas needing high fire risk machinery or installations, often coupled with an automatic gas extinguishing system

(5) Environments that are unsuitable for other types of detectors

Heat Detector

NFPA 72 - 2022

3.3.77.11 **Heat Detector**

A fire detector that detects either abnormally high temperature or rate-of-temperature rise, or both.

Fixed Temperature Heat Detector

A device that responds when its operating element becomes heated to a predetermined temperature level.

Rate-of-Rise Heat Detector

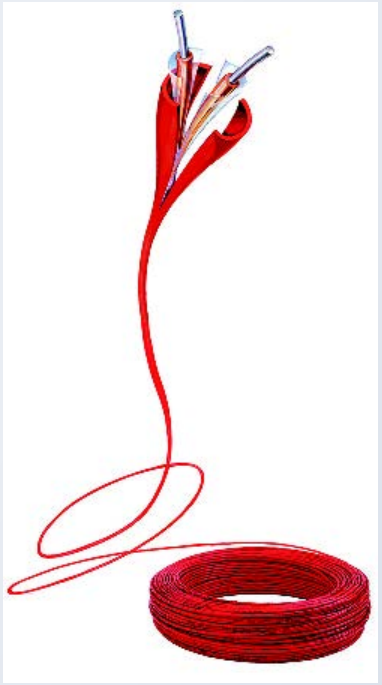
A device that responds when the temperature rises at a rate exceeding a predetermined value.

Line - Type Heat Detector

A heat detector in which the detection is continuous along a path.

Fixed Temperature / Rate-of-Rise Heat Detector

Linear Heat Detector



Heat Detector (Continuation)

NFPA 72 - 2022

Ambient Ceiling Temperature

17.6.2.3.1 Detectors having fixed-temperature or rate-compensated elements shall be selected in accordance with Table 17.6.2.1 for the maximum expected ambient ceiling temperature.

17.6.2.3.2 The temperature rating of the detector shall be at least **20°F (11°C)** above the maximum expected temperature at the ceiling.

Δ **Table 17.6.2.1 Temperature Classification and Color Code for Heat-Sensing Fire Detectors**

Temperature Classification	Temperature Rating Range		Maximum Ceiling Temperature		Color Code
	°F	°C	°F	°C	
Low	100–134	38–56	80	28	Uncolored
Ordinary	135–174	57–79	115	47	Uncolored
Intermediate	175–249	80–121	155	69	White
High	250–324	122–162	230	111	Blue
Extra high	325–399	163–204	305	152	Red
Very extra high	400–499	205–259	380	194	Green
Ultra high	500–575	260–302	480	249	Orange

Heat Detector Spacing

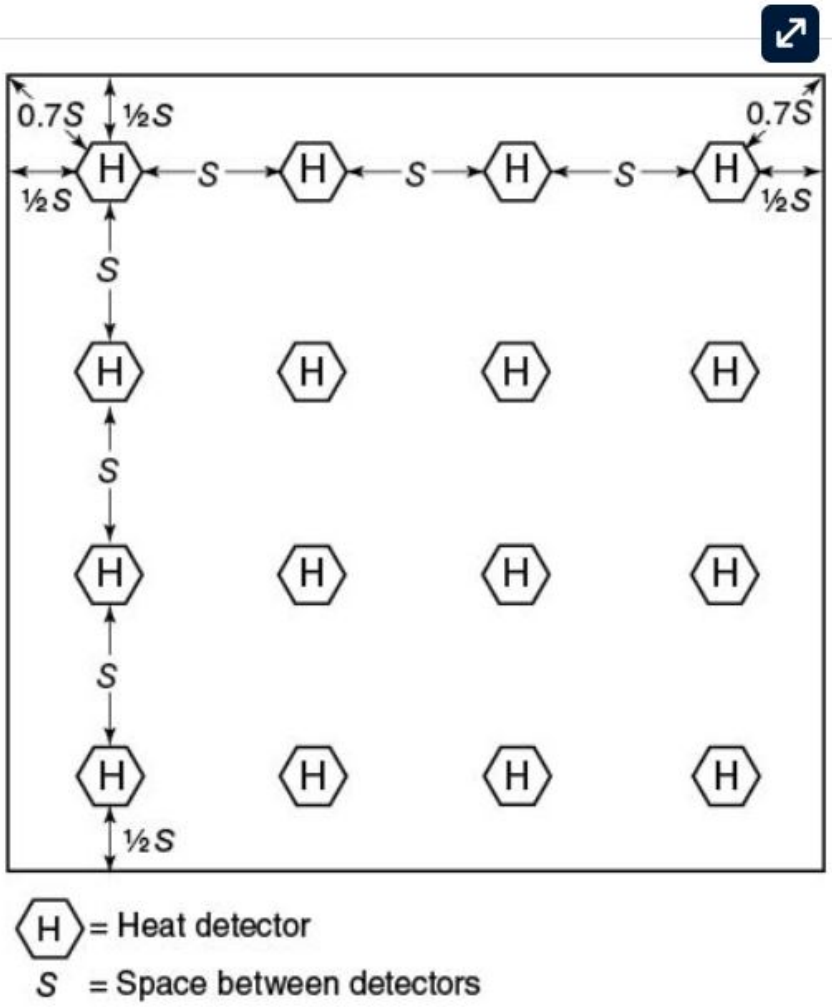


Figure A.17.6.3.1.1(a) Spot-Type Heat Detectors.

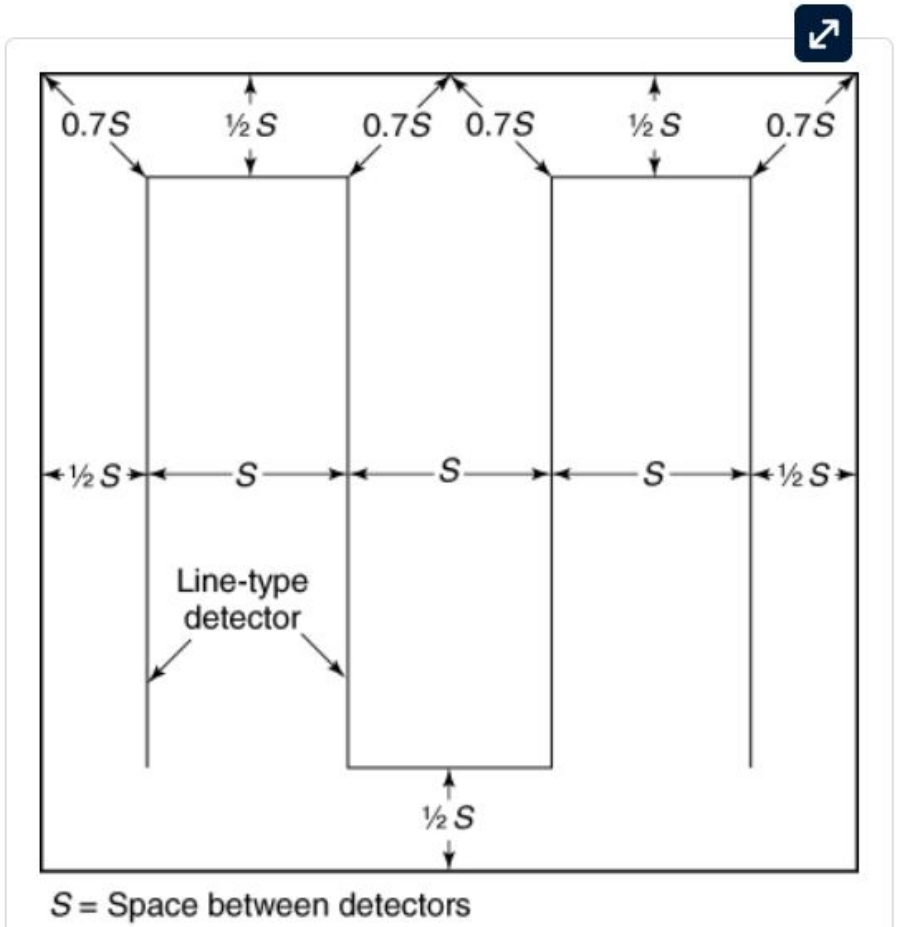
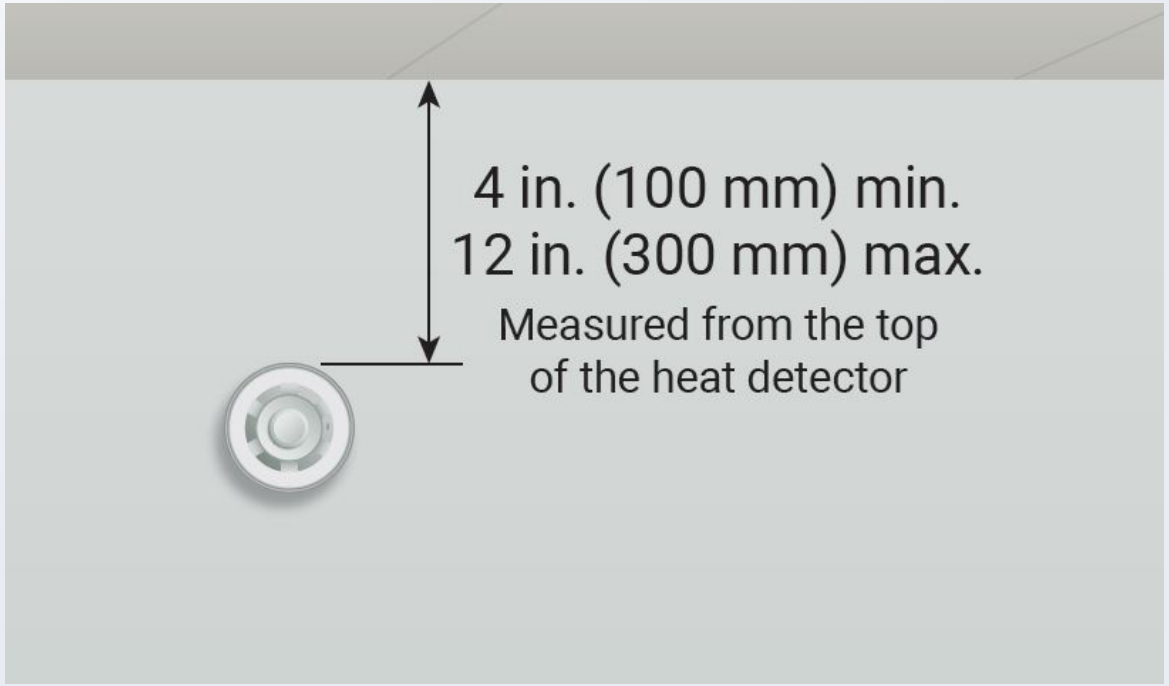


Figure A.17.6.3.1.1(b) Line-Type Detectors — Spacing Layouts, Smooth Ceiling.

Spot-type Heat Detector
Installation Consideration

NFPA 72 - 2022
17.6.3.1.3.1
Spot-type heat-sensing fire detectors shall be located on the ceiling not less than 4 in. (100 mm) from the sidewall or on the sidewalls between 4 in. and 12 in. (100 mm and 300 mm) from the ceiling.



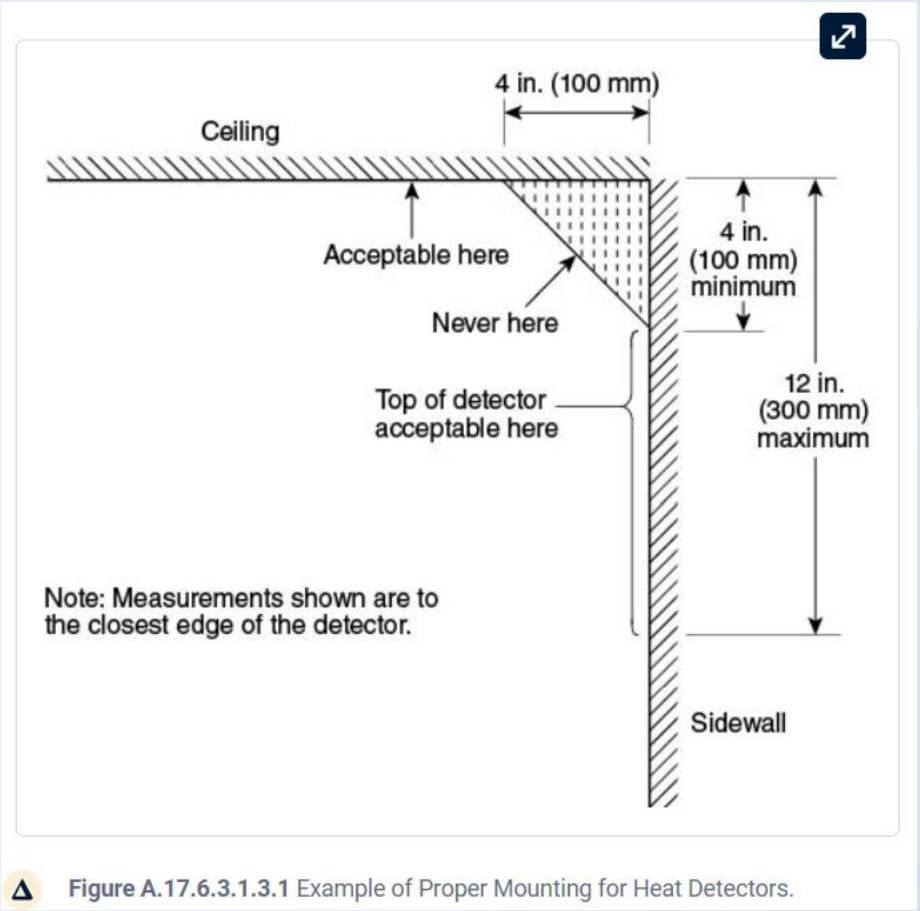
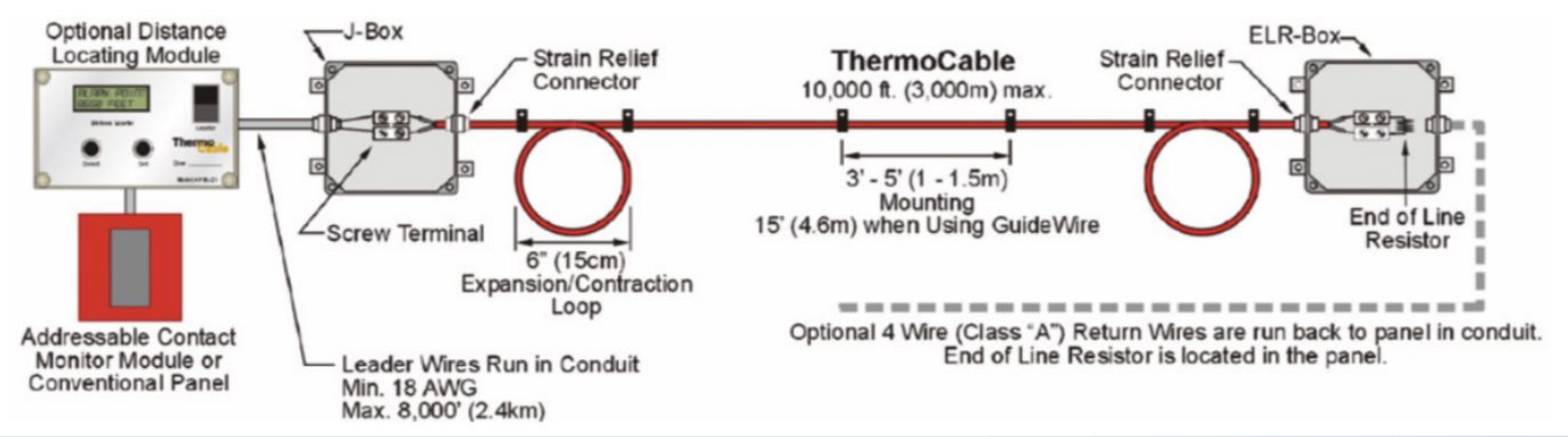


Figure A.17.6.3.1.3.1 Example of Proper Mounting for Heat Detectors.

Some Applications of Linear Heat Detector (Refer to Manufacturer)

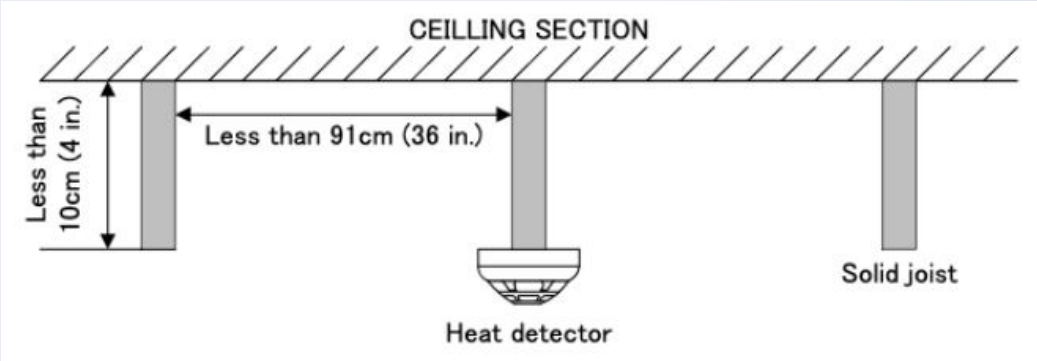
- *Power Generation*
- *Warehousing and Cold Storage*
- *Transportation*
- *Oil and Gas*
- *Mining and Materials Processing*


Optional Distance Locating Module
J-Box
Strain Relief Connector
ThermoCable
10,000 ft. (3,000m) max.
Strain Relief Connector
ELR-Box
3' - 5' (1 - 1.5m) Mounting
15' (4.6m) when Using GuideWire
Screw Terminal
6" (15cm) Expansion/Contraction Loop
End of Line Resistor
Addressable Contact Monitor Module or Conventional Panel
Leader Wires Run in Conduit
Min. 18 AWG
Max. 8,000' (2.4km)
Optional 4 Wire (Class "A") Return Wires are run back to panel in conduit.
End of Line Resistor is located in the panel.

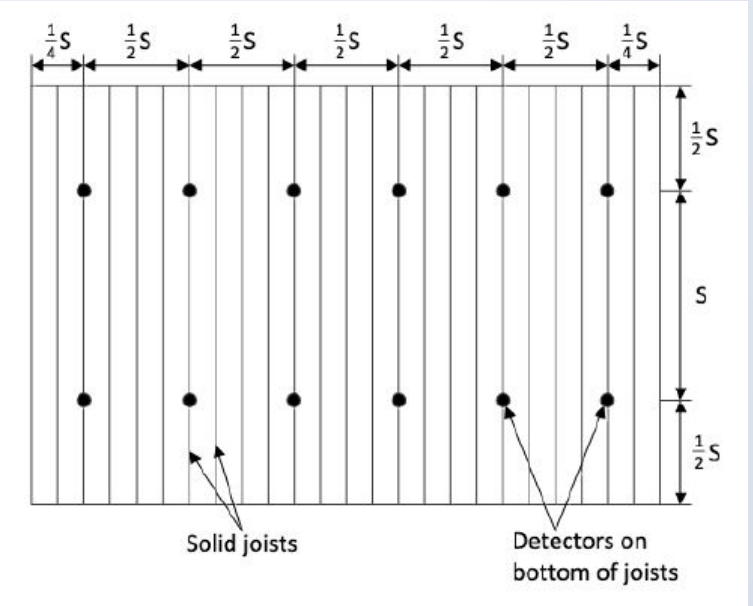
Heat Detector Placement at Solid Joist

*A **Solid Joist** is defined as a solid member projecting down from the ceiling surface for a distance of more than 4 in. (10 cm) and spaced at intervals of 36 in. (91 cm) or less, center to center.*

The spacing of heat detectors must be reduced by 50% in the direction perpendicular to the joist. The detectors shall be mounted on the bottom of the joists.



Heat Detector Spacing for Solid Joist Construction (Elevation View)



Heat Detector Spacing for Solid Joist Construction (Plan View)

Heat Detector Placement at Beams

D/H > 0.1 and W/H > 0.4

Mount the heat detector on the ceiling.

D/H < 0.1 or W/H < 0.4

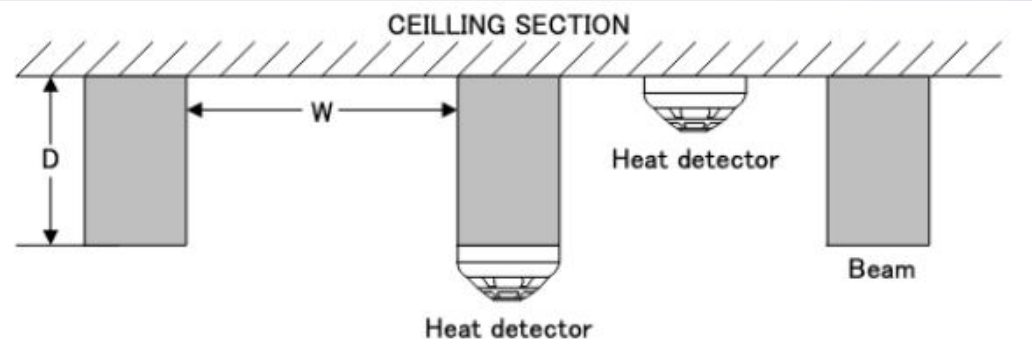
Mount the heat detector on the bottom of the beam.

Legend:

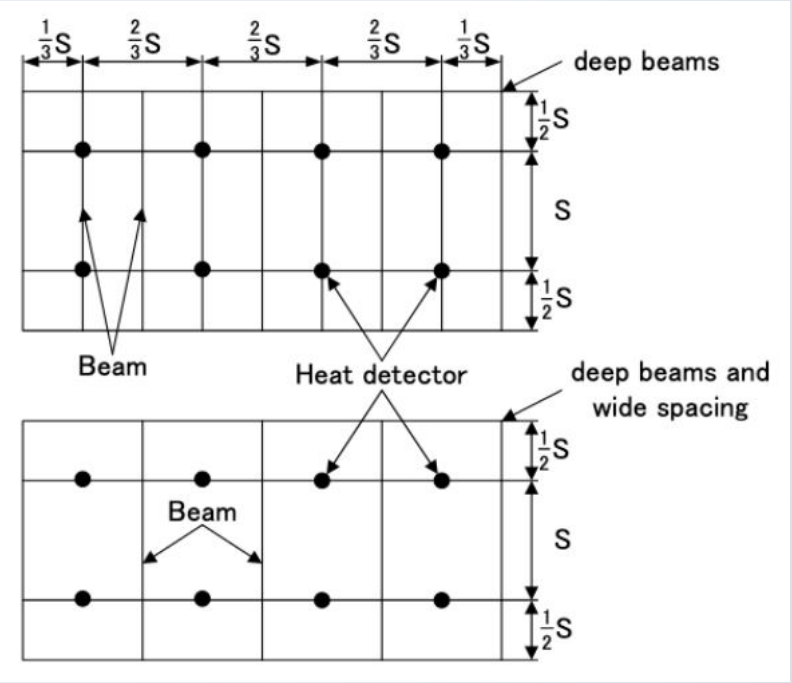
D = Beam Depth

H = Ceiling Height

W = Width between Beams



Heat Detector Spacing for Beam Construction (Elevation View)



Smoke Detector Spacing for Beam Construction (Plan View)

Heat Detector Spacing at High Ceiling

NFPA 72 - 2022

17.6.3.5.1 Unless otherwise modified by 17.6.3.5.2, on ceilings 10 ft. to 30 ft. (3.0 m to 9.1 m) high, heat detector spacing shall be reduced in accordance with Table 17.6.3.5.1 prior to any additional reductions for beams, joists, or slope, where applicable.

If ceiling height is more than 10 ft. (3 m), the heat detector spacing must be reduced by factors that range from 0.91 times the listed spacing for up to 12 ft. (3.65 m) to 0.34 times the listed spacing for ceiling heights up to 30 ft. (9.1 m).

Δ Table 17.6.3.5.1 Heat Detector Spacing Reduction Based on Ceiling Height

Ceiling Height Greater than (>)		Up to and Including		Multiply Listed Spacing by
ft	m	ft	m	
0	0	10	3.0	1.00
10	3.0	12	3.7	0.91
12	3.7	14	4.3	0.84
14	4.3	16	4.9	0.77
16	4.9	18	5.5	0.71
18	5.5	20	6.1	0.64
20	6.1	22	6.7	0.58
22	6.7	24	7.3	0.52
24	7.3	26	7.9	0.46
26	7.9	28	8.5	0.40
28	8.5	30	9.1	0.34

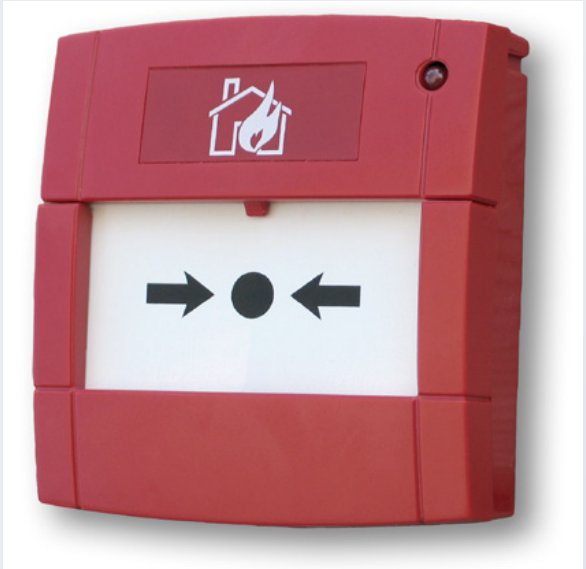
Manual Initiating Devices

*Manual fire alarm activation is typically achieved through the use of a **Pull Station** (USA & Canada) or **Call Point** (Europe, Australia, Asia, and Germany), which sounds the evacuation alarm for the relevant building or zone.*

Manual fire alarm activation requires human intervention as distinct from automatic fire alarm activation such as that provided through the use of smoke/heat detectors.

Pull Stations

Call Point



Manual Pull Station

RA 9514 - Revised IRR - 2019
SECTION 10.2.6.6 FIRE DETECTION, ALARM, AND COMMUNICATION SYSTEM
B. Signal Initiation

3. A manual fire alarm box shall be provided in the natural path of escape from fire, near each exit from an area, and shall be readily accessible, unobstructed and at visible points.

NFPA 72 - 2022
17.15.7 Manually actuated alarm-initiating devices shall be permitted to be **single action** or **double action**.

- ***Single Action*** *– require a single operation to activate it. Generally pulling down action.*
- ***Double Action*** *– require two distinct operations to activate it. A setup and an activating action.*

Manual Pull Station (Continuation)

NFPA 72 - 2022

17.15.8 Listed **protective covers** shall be permitted to be installed over single- or double-action manually actuated alarm-initiating devices.

17.15.9.3 Unless installed in an environment that precludes the use of red paint or red plastic, manual fire alarm boxes shall be **red** in color.

Single Action

Double Action

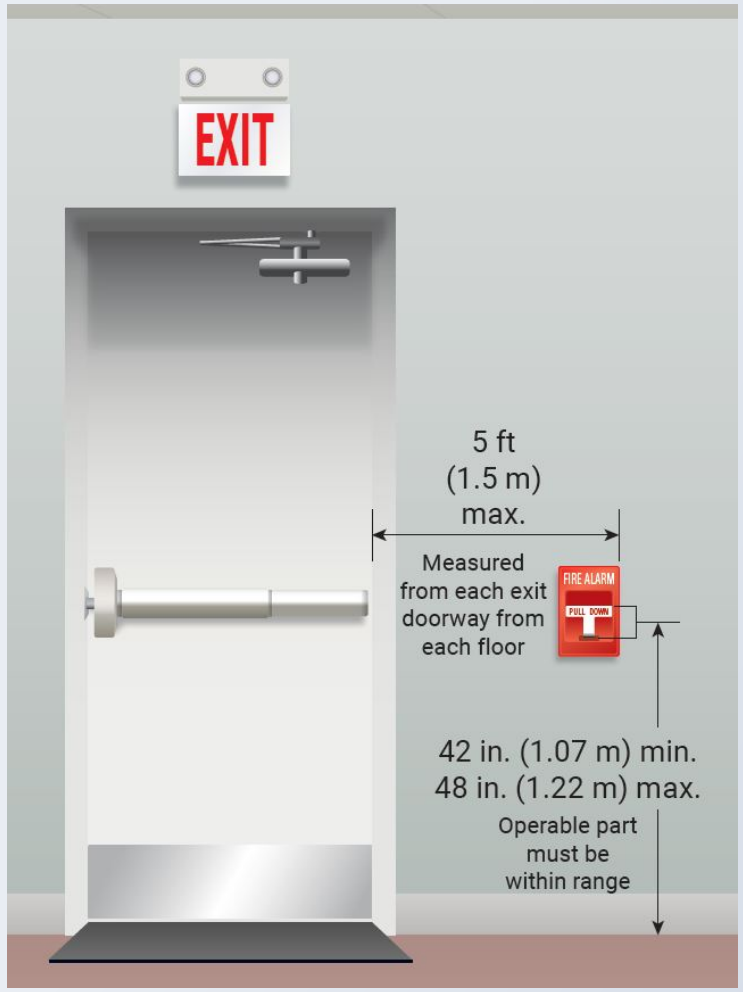
Manual Fire Alarm Boxes Mounting

NFPA 72 - 2022
17.15.6 The operable part of a manually actuated alarm initiating device shall be **not less than 42 in. (1.07 m) and not more than 48 in. (1.22 m)** from the finished floor.

Philippines Electronics Code Book 2 on FDAS
*2.6.2 Manual fire alarm stations shall be installed at a height of **1.4 meters** above the finished floor level and shall be located at easily accessible points, free from obstructions.*

NFPA 72 - 2022
17.15.9.4 Manual fire alarm boxes shall be located within **5 ft. (1.5 m)** of each exit doorway on each floor.

Philippines Electronics Code Book 2 on FDAS
*2.6.2 Manual fire alarm stations shall be located within **1.2 meters** of each exit door on each floor.*



Manual Fire Alarm Boxes Mounting (Continuation)

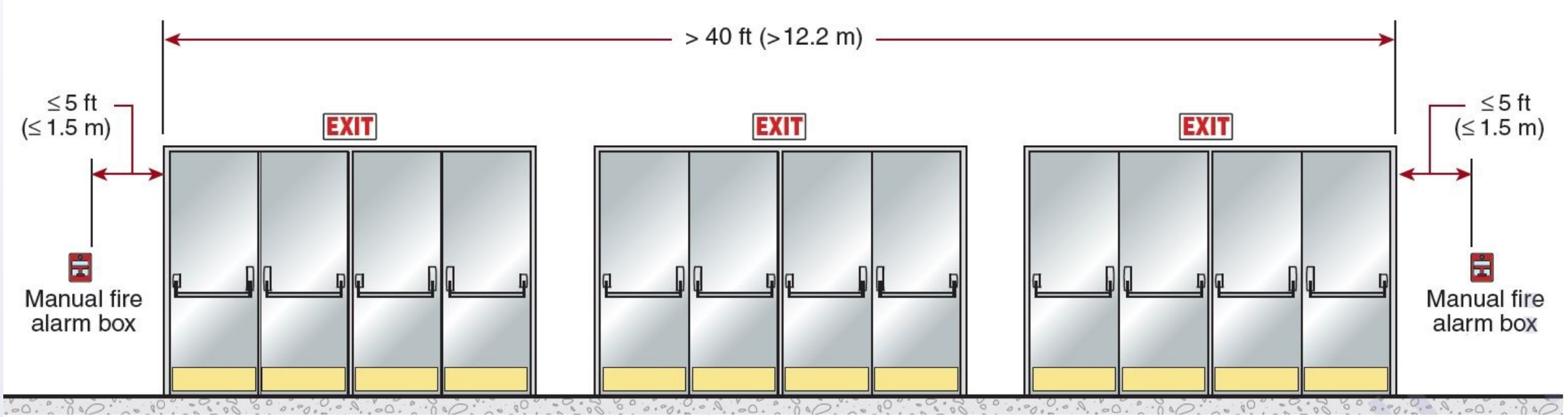
NFPA 72 - 2022
17.15.9.5 **Additional manual fire alarm boxes** shall be provided so that the travel distance to the nearest manual fire alarm box will not exceed **200 ft. (61 m)**, measured horizontally on the same floor.

RA 9514 - Revised IRR - 2019
SECTION 10.2.6.6 FIRE DETECTION, ALARM, AND COMMUNICATION SYSTEM
B. Signal Initiation
*4. Additional fire alarm boxes shall be so located that from any part of the building not more than **thirty meters (30 m)** horizontal distance on the same floor must be traversed in order to reach a fire alarm box.*

Philippines Electronics Code Book 2 on FDAS
*2.6.5 Additional manual fire alarm stations shall be so located that from any point within the building, the travel distance to activate the alarm shall not be more than **30 meters**, measured horizontally on the same floor.*

Manual Fire Alarm Boxes Mounting (Continuation)

NFPA 72 - 2022
17.15.9.6 Manual fire alarm boxes shall be mounted on both sides of grouped openings over **40 ft. (12.2 m)** in width, and within **5 ft. (1.5 m)** of each side of the grouped opening.



Locations of Manual Fire Alarm Boxes at Grouped Openings.

Notification Appliance

NFPA 72 - 2022

3.3.189 **Notification Appliance**
A fire alarm system component such as a bell, horn, loudspeaker, visual notification appliance, or text display that provides audible, tactile, or visual outputs, or any combination thereof.

3.3.190 **Notification Appliance Circuit (NAC)**. A circuit or path directly connected to a notification appliance(s).

There are many types of notification appliances that are available. The most common are **audible** and **visual** notification appliances. Other types of notification appliances are used, including tactile notification appliances in the form of *bed shakers* or *vibrating pagers*.

Philippine Electronics Code Book 2
1.4.15.3 Tactile Notification Appliance – A notification appliance that warns by the sense of touch or vibration.

Olfactory (relating to a sense of smell) notification appliances are often used in mines and other hazardous locations.

Audible Notification Appliance

NFPA 72 - 2022
3.3.189.1 A notification appliance that alerts by the sense of hearing.

Examples are bells, horns, and speakers.

Bell

Horn

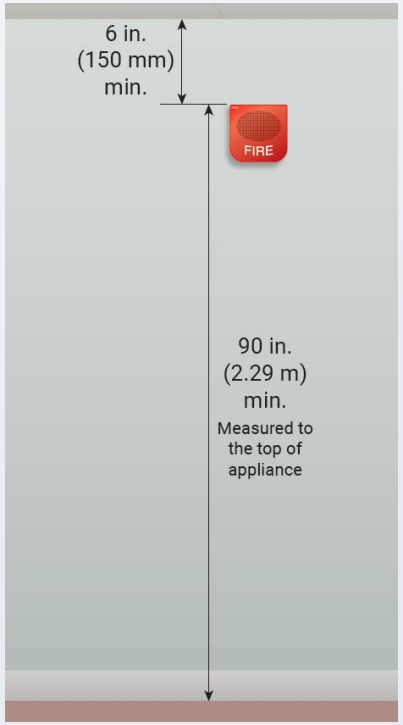
Speaker

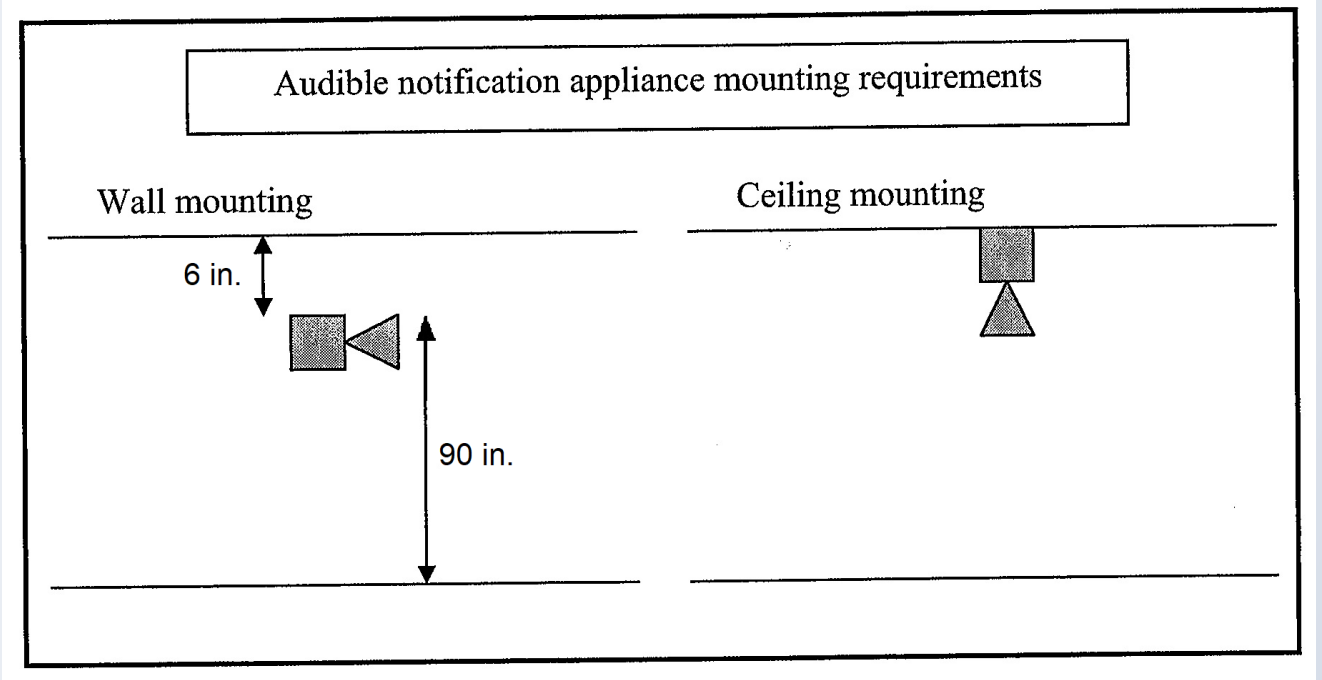
Location and Mounting of Audible Notification Appliance

NFPA 72 - 2022

18.4.9.1 If ceiling heights allow, wall-mounted appliances shall have their tops above the finished floors at heights of not less than **90 in. (2.29 m)** and below the finished ceilings at distances of not less than **6 in. (150 mm)**.

18.4.9.2 Ceiling-mounted or recessed appliances shall be permitted.





Distinctive Evacuation Signal
NFPA 72 - 2022

18.4.2.1 To meet the requirements of Section 10.10 ***(its about Distinctive Signals)***, the alarm audible signal pattern used to notify building occupants of the need to evacuate (leave the building) or relocate (from one area to another) shall be the **standard alarm evacuation signal** consisting of a **three-pulse temporal pattern**. The pattern shall be in accordance with ANSI/ASA S3.41, *Audible Emergency Evacuation (E2) and Evacuation Signals With Relocation Instructions (ESRI)*.

**If a speaker appliance is used as an alarm evacuation signal, the pre-tone is Temporal 3 followed by a Voice Message.*

A.18.4.2.1
The temporal pattern can be produced by any audible notification appliance, as illustrated in Figure A.18.4.2.1(a) and Figure A.18.4.2.1(b).

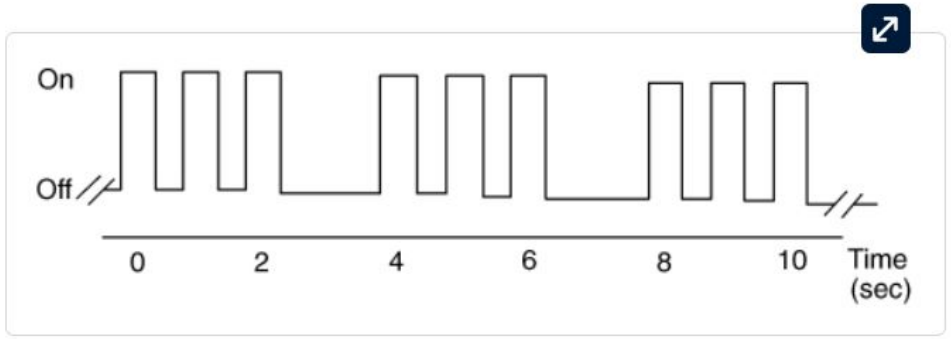


Figure A.18.4.2.1(a) Temporal Pattern Imposed on Signaling Appliances That Emit Continuous Signal While Energized.

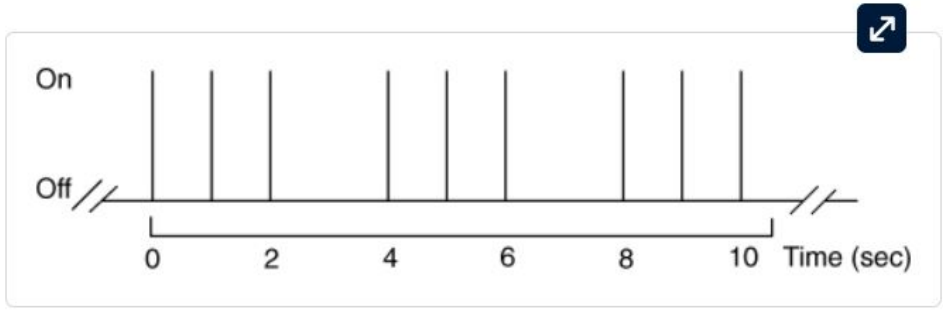


Figure A.18.4.2.1(b) Temporal Pattern Imposed on Single-Stroke Bell or Chime.

Sound Pressure Level

- *Average ambient sound levels and signal sound output levels are expressed in **Decibel (dB)**. A Decibel is a measure of sound pressure level or loudness.*

NFPA 72 - 2022
A.18.4.4
The typical average ambient sound level for the occupancies specified in **Table A.18.4.4** are intended only for design guidance purposes. The typical average ambient sound levels specified should not be used in lieu of actual sound level measurements.

Δ Table A.18.4.4 Average Ambient Sound Level According to Location

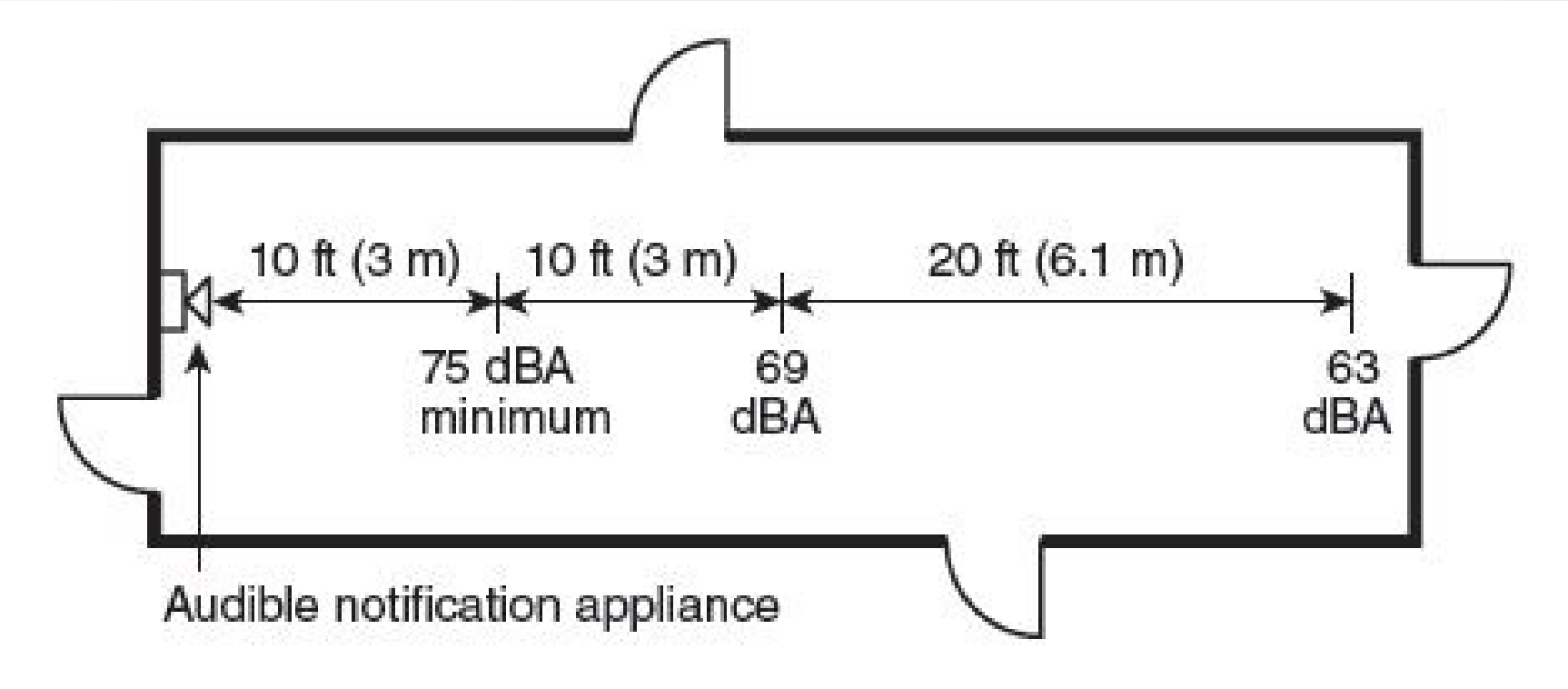
Location	Average Ambient Sound Level (dBA)
Business occupancies	54
Educational occupancies	45
Industrial occupancies	88
Institutional occupancies	50
Mercantile occupancies	40
Mechanical rooms	91
Piers and water-surrounded structures	40
Places of assembly	60
Residential occupancies	35
Storage occupancies	30
Thoroughfares, high-density urban	70
Thoroughfares, medium-density urban	55
Thoroughfares, rural and suburban	40
Tower occupancies	35
Underground structures and windowless buildings	40
Vehicles and vessels	50

NFPA 72 - 2022

A.18.4.4 (Continuation)

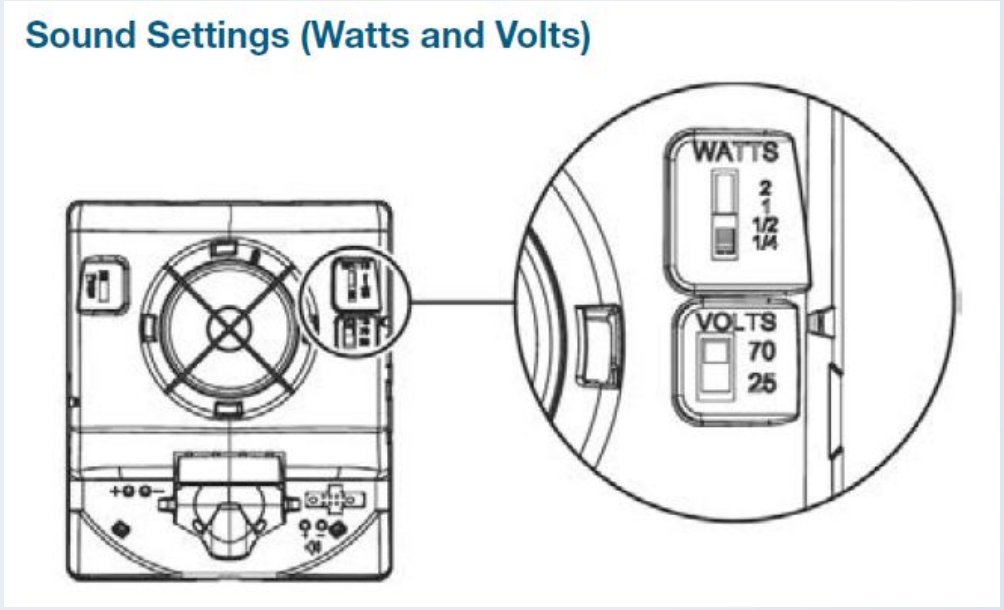
Sound levels can be significantly reduced due to distance and losses through building elements. Every time the distance from the source **doubles**, the **sound level decreases by about 6 decibels (dB)**. Audible notification appliances are typically rated by manufacturers' and testing agencies at **10 ft (3 m)** from the appliance.

6 dB Rule of Distance



3 dB Rule of Power (Wattage)

Every time the power (wattage) is doubled, the sound level will increase 3 dB.



Sound Level Output

Voltage setting	Wattage setting	Reverberant (UL 1480)	Anechoic (CAN/ ULC-S541)
25V / 70V	¼W	78	78
	½W	81	81
	1W	84	84
	2W	87	87

Signaling

Using audible, visual or other means ***to provide notification*** *of a fire alarm, supervisory, or trouble signal.*

Two Types of Signaling Mode:

1.) Public Mode

2.) Private Mode

Public Mode versus Private Mode

Public Mode

Public mode signaling involves signaling all of the occupants of the building of an emergency. This action may include complete evacuation of the building, selective/partial evacuation (floor by floor or zone by zone), or relocation to areas of refuge within the building.

Examples are business, educational, industrial, and storage occupancies.

NFPA 72 - 2022

18.4.4.1 To ensure that audible public mode signals are clearly heard, unless otherwise permitted by 18.4.4.2 through 18.4.4.5, they shall have a sound level at least **15 dB above the average ambient sound level** or 5 dB above the maximum sound level having a duration of at least 60 seconds, whichever is greater, measured 5 ft (1.5 m) above the floor in the area required to be served by the system using the A-weighted scale (dBA).

Public Mode versus Private Mode (Continuation)

Private Mode

Private mode signaling involves signaling only those directly concerned with taking prescribed action in the event of an emergency.

Examples may include operators in a supervising station, building receptionists, nurses at a nursing station, plant managers, emergency response team members, or other specially trained personnel.

Private mode signaling require lower levels of audibility and light intensity since they are not required for the general public.

NFPA 72 - 2022

18.4.5.1 To ensure that audible private mode signals are clearly heard, they shall have a sound level at least **10 dB above the average ambient sound level** or 5 dB above the maximum sound level having a duration of at least 60 seconds, whichever is greater, measured 5 ft (1.5 m) above the floor in the area required to be served by the system using the A-weighted scale (dBA).

Visual Notification Appliance

NFPA 72 - 2022
3.3.189.3 A notification appliance that alerts by the sense of sight.

Example are strobes, lamps and beacons.

Strobe (LED Type)

Strobe (Xenon Type)

Hazardous Location Strobe

Combination Audible and Visual Notification Appliance

Example are horn/strobe and speaker/strobe.

Wall Mounted Horn/Strobe or Speaker/Strobe

Ceiling Mounted Horn/Strobe or Speaker/Strobe

Visual Notification Appliance (Continuation)

RA 9514 – Revised IRR – 2019

SECTION 10.2.6.6 FIRE DETECTION, ALARM, AND COMMUNICATION SYSTEMS

D. Occupant Notification
*4. Notification signals for occupants to evacuate shall be by **audible** and **visible** signals in accordance with NFPA 72, or other means of notification subject to the determination and approval of the C/MFM (City/Municipal Fire Marshal) having jurisdiction.*

Visual Notification Appliance (Continuation)

NFPA 72 - 2022

18.5.3.5 Visual notification appliances used for fire alarm signaling only or to signal the intent for complete evacuation shall be **clear** or **nominal white** and shall not exceed 1000 cd (effective intensity).

18.5.3.6 Visual notification appliances used to signal occupants to seek information or instructions shall be clear, nominal white, or other color as required by the emergency plan and the authority having jurisdiction for the area or building.

The color of the lens on the strobe affects the light output. If a strobe is fitted with a white lens with a relative light of 100%.

An Amber lens on the same strobe would provide only 70 to 100%, a Blue lens is 35 to 70%, and a Red lens is 25 to 40%.

Visual Notification Appliance (Continuation)

NFPA 72 - 2022

18.4.1.1 An average ambient sound level greater than **105 dBA** shall require the use of a visual notification appliance (s) in accordance with Section 18.5 where the application is public mode or Section 18.6 where the application is private mode.

18.5.3.1 The flash rate shall not exceed **two flashes per second (2 Hz)** nor be less than **one flash every second (1 Hz)** throughout the listed voltage range of the appliance.

*Visual notification appliances are rated in intensity (brightness) stated in **candela (cd)**.*

Location and Mounting of Visual Notification Appliance

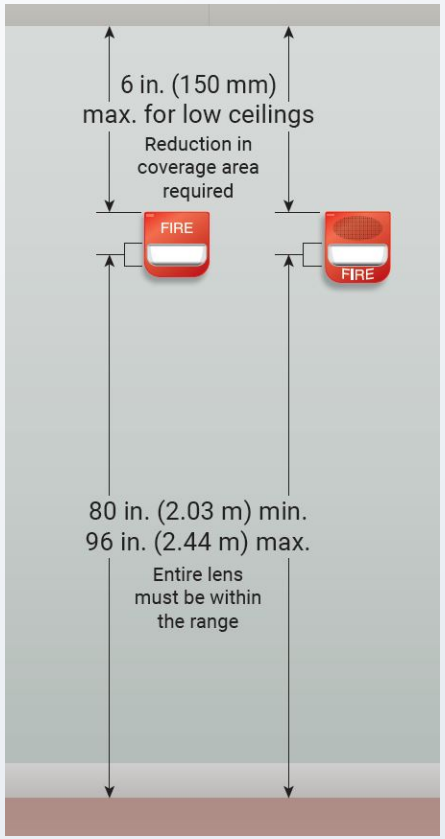
NFPA 72 - 2022

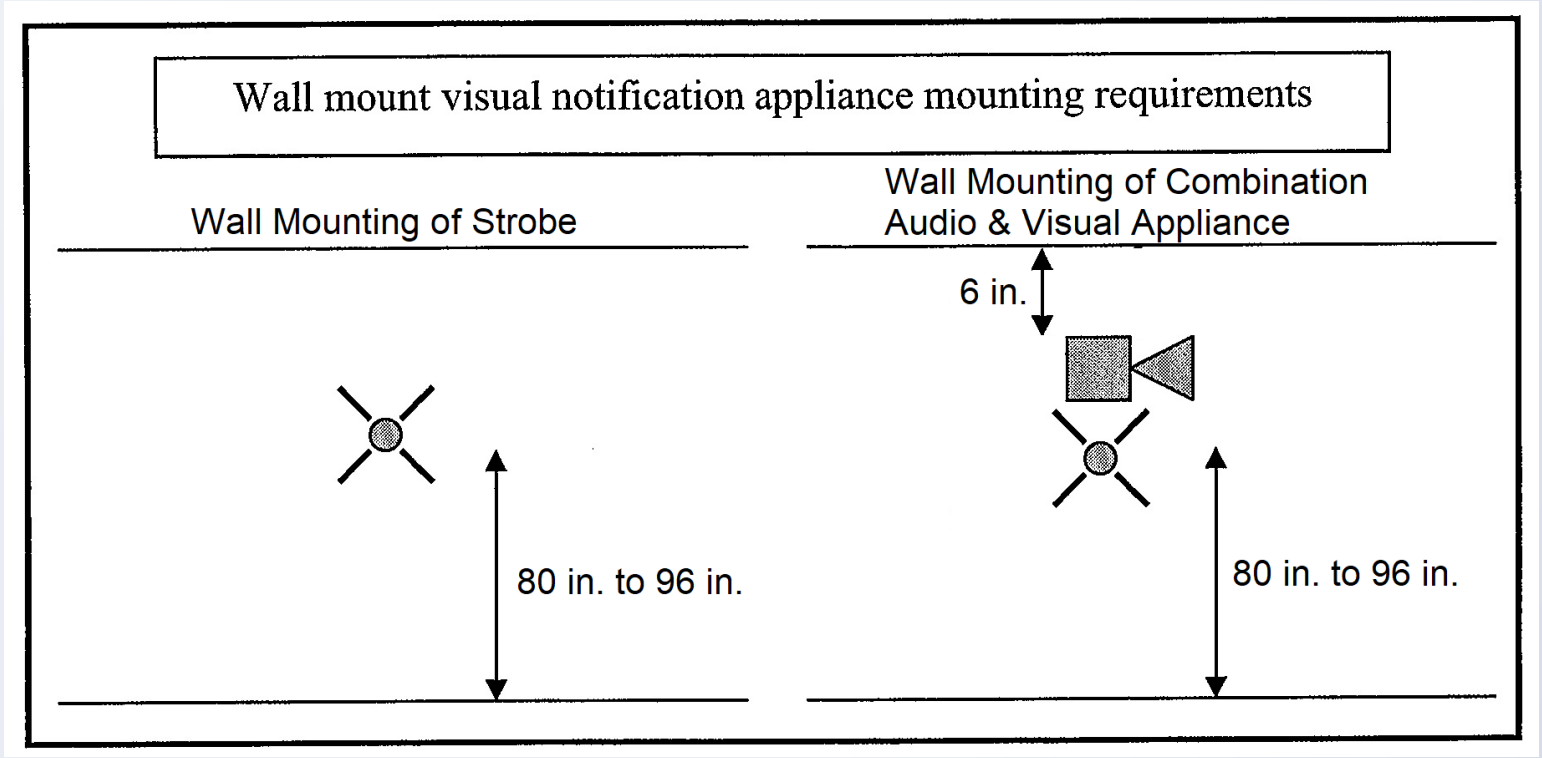
18.5.5.1 Wall-mounted appliances shall be mounted such that the entire lens is not less than **80 in. (2.03 m)** and not greater than **96 in. (2.44 m)** above the finished floor.

18.5.5.2 Where low ceiling heights do not permit wall mounting at a minimum of 80 in. (2.03 m), wall mounted visual notification appliances shall be mounted within **6 in. (150 mm)** of the ceiling.

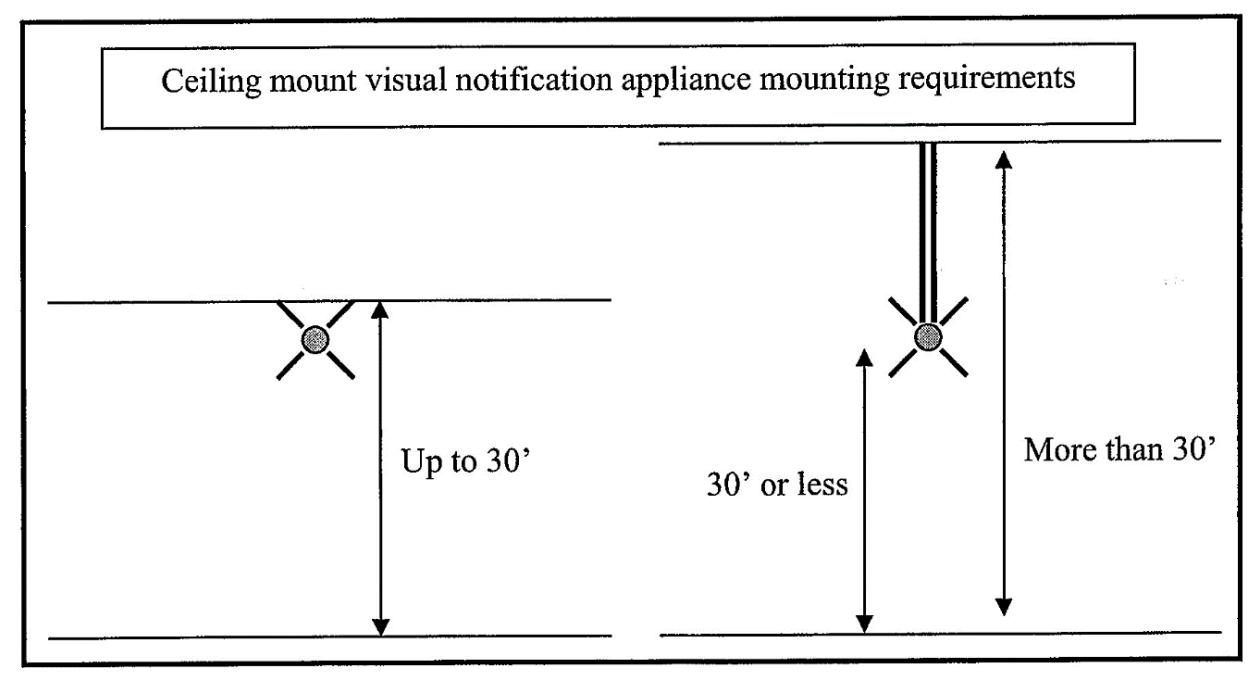
18.5.5.7.6 If ceiling heights exceed 30 ft. (9.1 m), ceiling-mounted visual notification appliances shall be **suspended** at or **below 30 ft. (9.1 m)**.

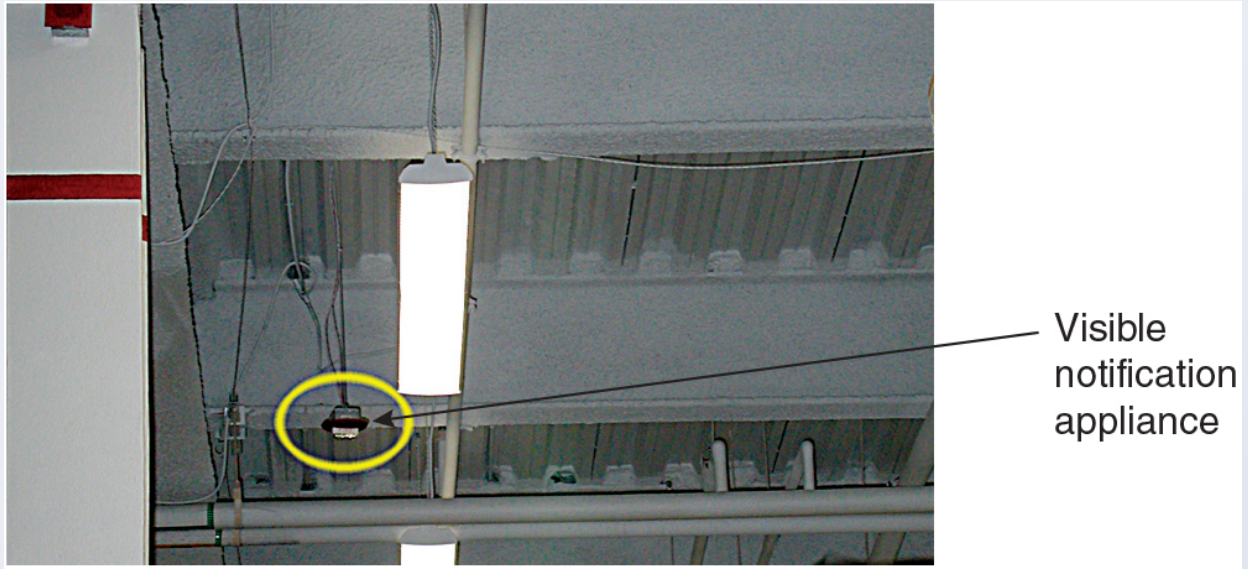
Wall Mounting of Visual Notification Appliance




Wall mount visual notification appliance mounting requirements
Wall Mounting of Strobe
80 in. to 96 in.
Wall Mounting of Combination
Audio & Visual Appliance
6 in.
80 in. to 96 in.

Ceiling Mounting of Visual Notification Appliance





NFPA 72 - 2022

18.5.5.7.1 Spacing shall be in accordance with either Table 18.5.5.7.1(a) and Figure 18.5.5.7.1 or Table 18.5.5.7.1(b).

Table 18.5.5.7.1(a) Room Spacing for Wall-Mounted Visual Notification Appliances

Maximum Room Size		Minimum Required Light Output [Effective Intensity (cd)]	
ft	m	One Visual Notification Appliance per Room	Four Visual Notification Appliances per Room (One per Wall)
20 × 20	6.10 × 6.10	15	NA
28 × 28	8.53 × 8.53	30	NA
30 × 30	9.14 × 9.14	34	NA
40 × 40	12.2 × 12.2	60	15
45 × 45	13.7 × 13.7	75	19
50 × 50	15.2 × 15.2	94	30
54 × 54	16.5 × 16.5	110	30
55 × 55	16.8 × 16.8	115	30
60 × 60	18.3 × 18.3	135	30
63 × 63	19.2 × 19.2	150	37
68 × 68	20.7 × 20.7	177	43
70 × 70	21.3 × 21.3	184	60
80 × 80	24.4 × 24.4	240	60
90 × 90	27.4 × 27.4	304	95
100 × 100	30.5 × 30.5	375	95
110 × 110	33.5 × 33.5	455	135
120 × 120	36.6 × 36.6	540	135
130 × 130	39.6 × 39.6	635	185

NA: Not allowable.

NFPA 72 - 2022

18.5.5.7.1 Spacing shall be in accordance with either Table 18.5.5.7.1(a) and Figure 18.5.5.7.1 or Table 18.5.5.7.1(b).

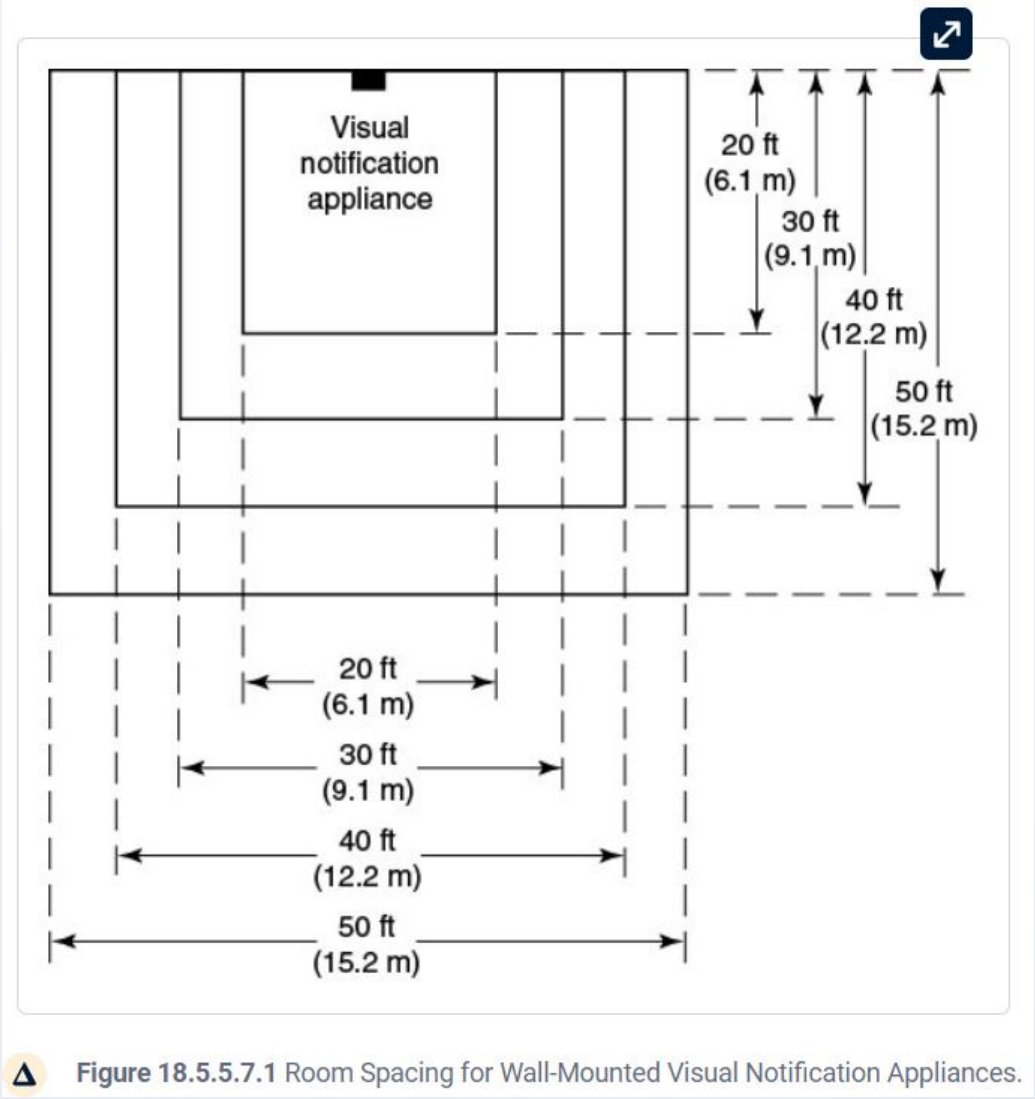


Figure 18.5.5.7.1 Room Spacing for Wall-Mounted Visual Notification Appliances.

NFPA 72 - 2022

18.5.5.7.1 Spacing shall be in accordance with either Table 18.5.5.7.1(a) and Figure 18.5.5.7.1 or Table 18.5.5.7.1(b).

Table 18.5.5.7.1(b) Room Spacing for Ceiling-Mounted Visual Notification Appliances

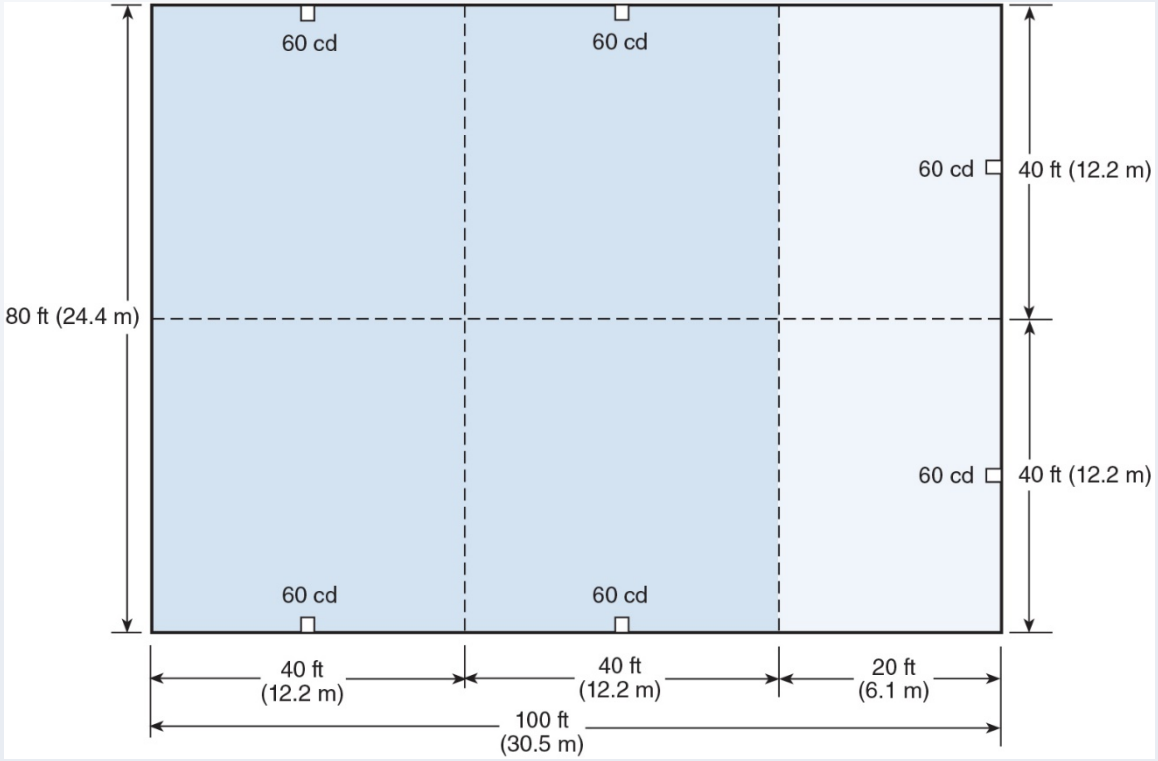
Maximum Room Size		Maximum Lens Height*		Minimum Required Light Output (Effective Intensity); One Visual Notification Appliance (cd)
ft	m	ft	m	
20 × 20	6.1 × 6.1	10	3.0	15
30 × 30	9.1 × 9.1	10	3.0	30
40 × 40	12.2 × 12.2	10	3.0	60
44 × 44	13.4 × 13.4	10	3.0	75
20 × 20	6.1 × 6.1	20	6.1	30
30 × 30	9.1 × 9.1	20	6.1	45
44 × 44	13.4 × 13.4	20	6.1	75
46 × 46	14.0 × 14.0	20	6.1	80
20 × 20	6.1 × 6.1	30	9.1	55
30 × 30	9.1 × 9.1	30	9.1	75
50 × 50	15.2 × 15.2	30	9.1	95
53 × 53	16.2 × 16.2	30	9.1	110
55 × 55	16.8 × 16.8	30	9.1	115
59 × 59	18.0 × 18.0	30	9.1	135
63 × 63	19.2 × 19.2	30	9.1	150
68 × 68	20.7 × 20.7	30	9.1	177
70 × 70	21.3 × 21.3	30	9.1	185

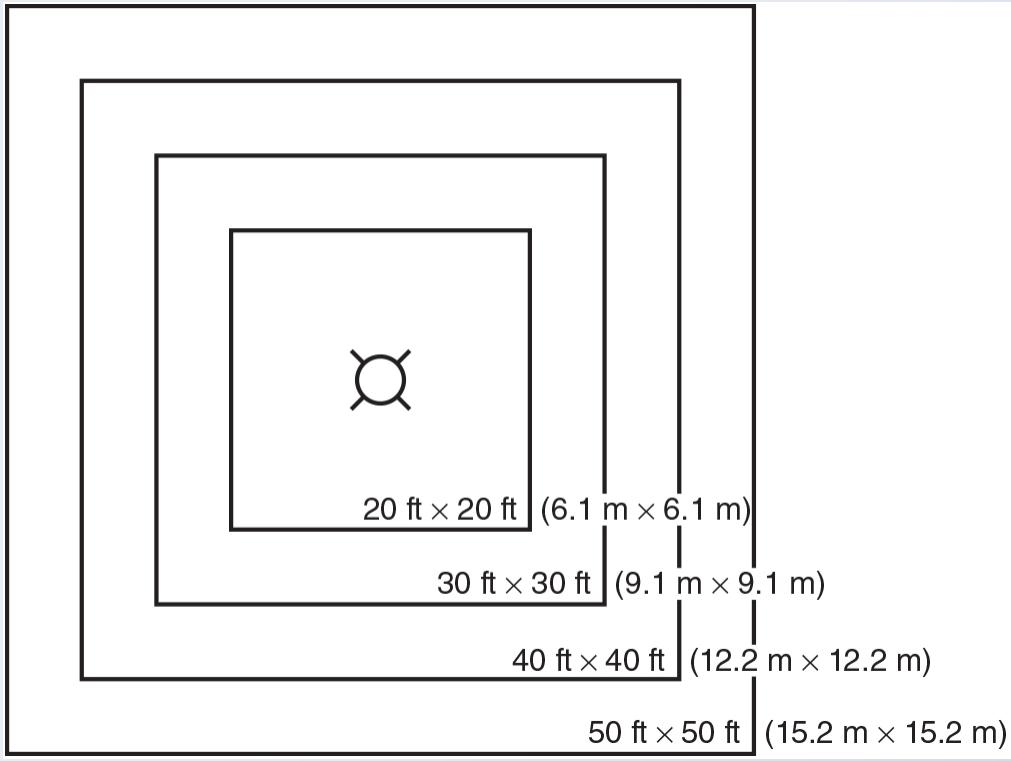
*This does not preclude mounting lens at lower heights.

NFPA 72 - 2022

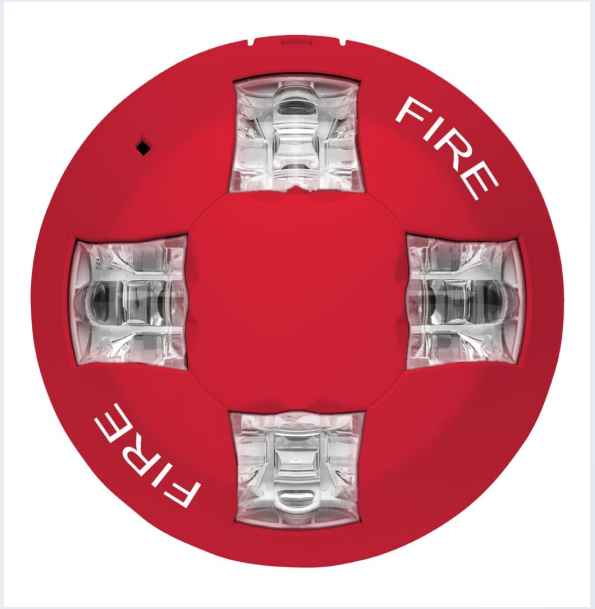
18.5.5.7.5 If a room configuration is not square, the square room size that allows the entire room to be encompassed or allows the room to be subdivided into multiple squares shall be used.

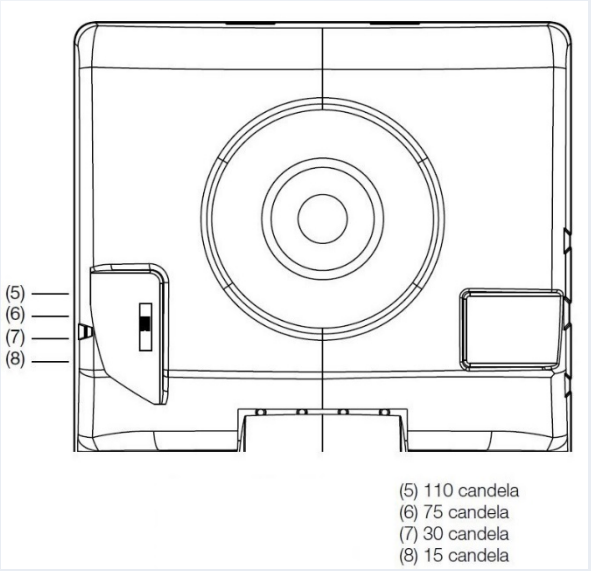
The key to proper coverage in irregular spaces is to divide the space into a series of squares and provide proper coverage for each square as if it were an independent space. The first exhibit illustrates this concept. Synchronization might be required, as described in 18.5.5.7.2. The second exhibit depicts a ceiling-mounted visual appliance centered in a room.

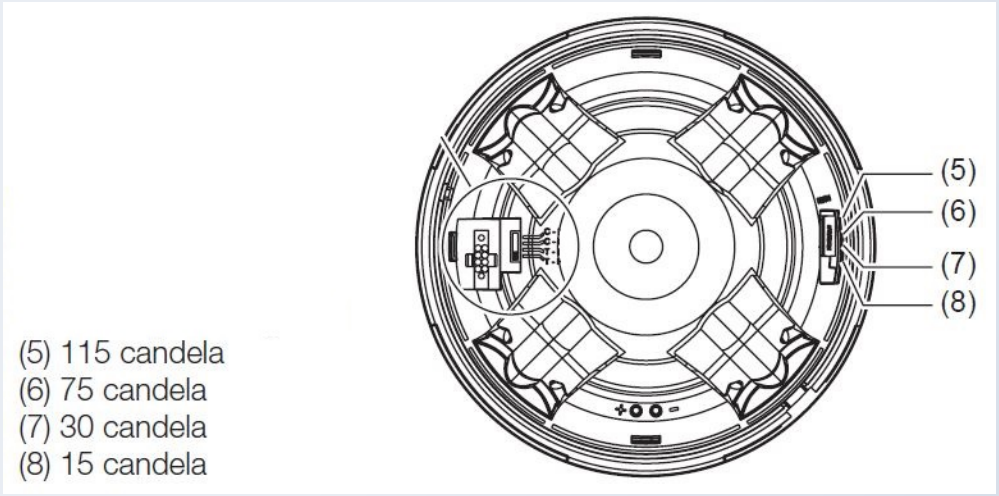




Sample Light Output Settings of Visual Notification Appliance (Candela)







Visual Notification Appliance at Corridor

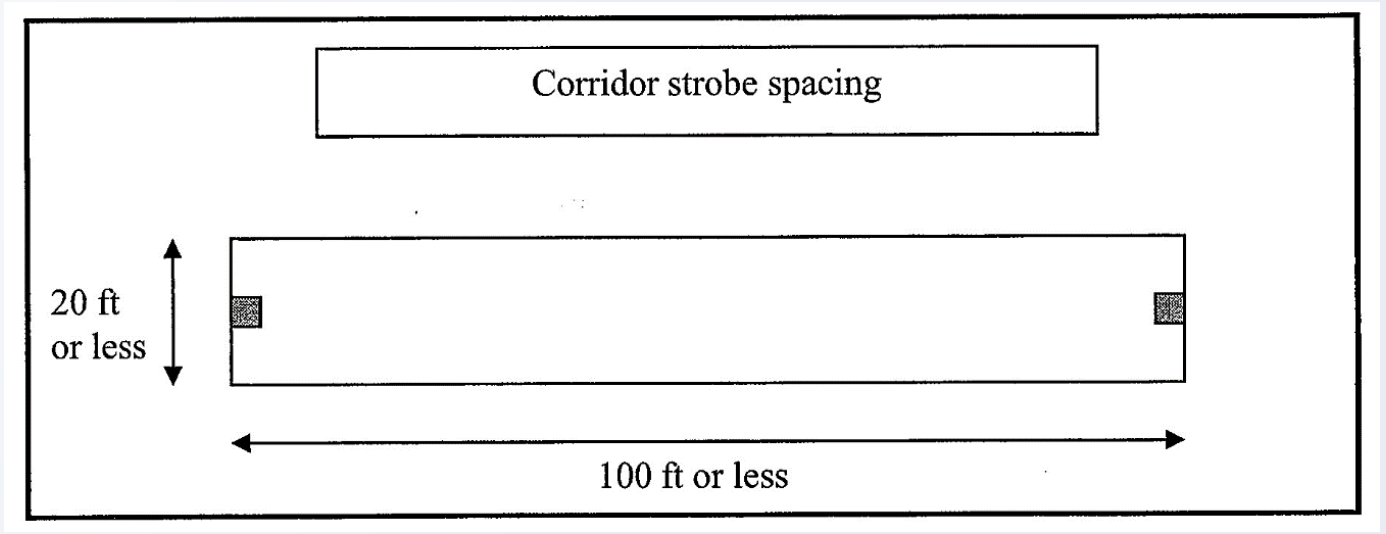
NFPA 72 - 2022

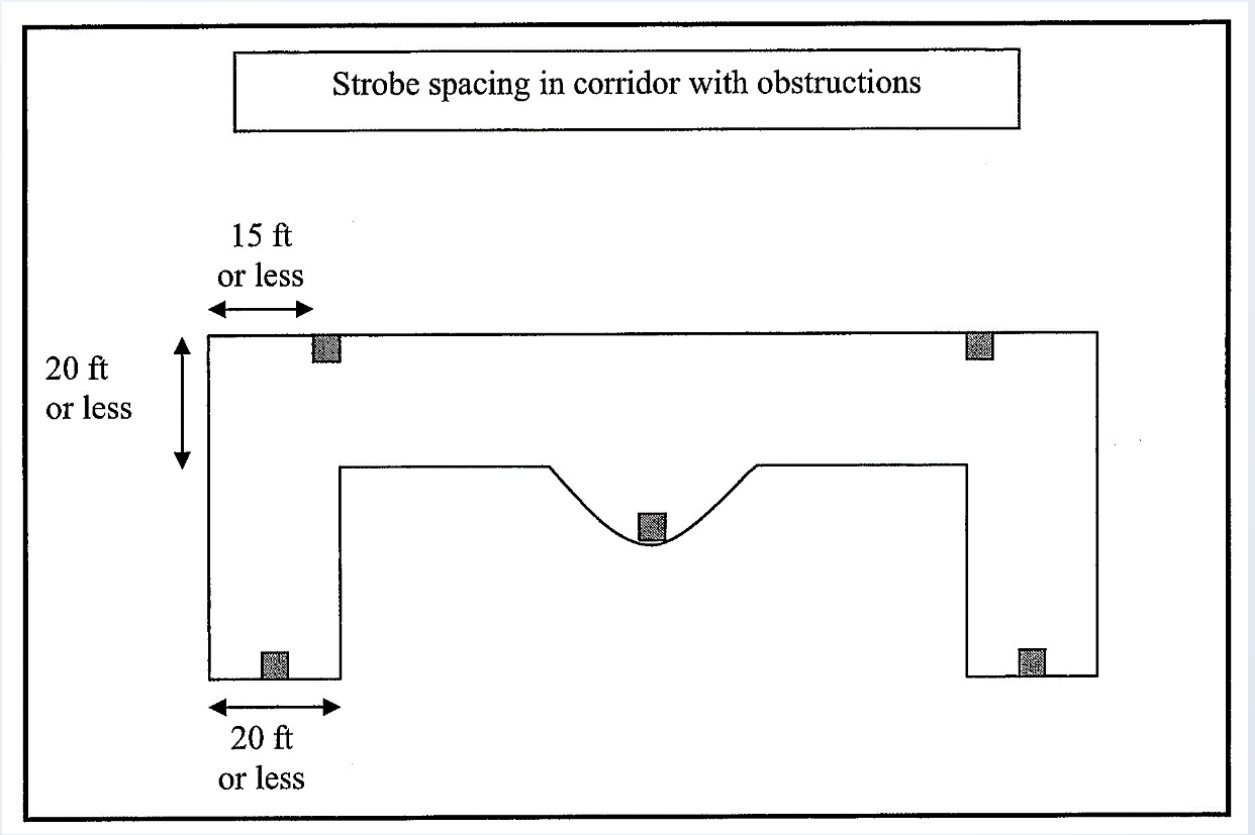
18.5.5.8.3 In a corridor application, visual notification appliances shall be rated not less than **15 cd**.

18.5.5.8.4 Corridors greater than **20 ft. (6.1 m)** wide shall comply with the spacing requirements for rooms in accordance with 18.5.5.7.

18.5.5.8.5 Visual notification appliances shall be located not more than **15 ft. (4.6.m)** from the end of the corridor with a separation not greater than **100 ft. (30.5 m)** between appliances.

18.5.5.8.6 If there is an interruption of the concentrated viewing path, such as a fire door or an elevation change, the area shall be treated as a separate corridor.


Corridor strobe spacing
20 ft
or less
100 ft or less


Strobe spacing in corridor with obstructions
15 ft
or less
20 ft
or less
20 ft
or less

Emergency Control Functions

Fire alarm system are frequently designed to interact with other building systems. Some of these include Elevators, Smoke Control & Management System, HVAC (Heating, Ventilation, and Air Conditioning) System, Door Release Services used for smoke & fire containment, and many more. The control of other devices by the control panel maybe accomplished using a relay, a signaling line circuit, or other listed method approved by the AHJ.

RA 9514 – Revised IRR – 2019
SECTION 10.2.6.6 FIRE DETECTION, ALARM, AND COMMUNICATION SYSTEMS
F. Emergency Control

1. A fire alarm and control system shall be arranged to activate automatically the control functions necessary to make the protected premises safer for building occupants.

2. Where required, the following functions shall be activated by the complete fire alarm system:
a. release of hold-open devices for doors or other opening protectives;
b. stairwell or elevator shaft pressurization;
c. smoke management or smoke control systems; and
d. unlocking of doors

Emergency Control Functions (Continuation)

NFPA 72 - 2022

21.2.4 Emergency control function interface devices shall be located within **3 ft. (0.9 m)** of the component controlling the emergency control function where the control circuit is not configured as a Class D circuit.

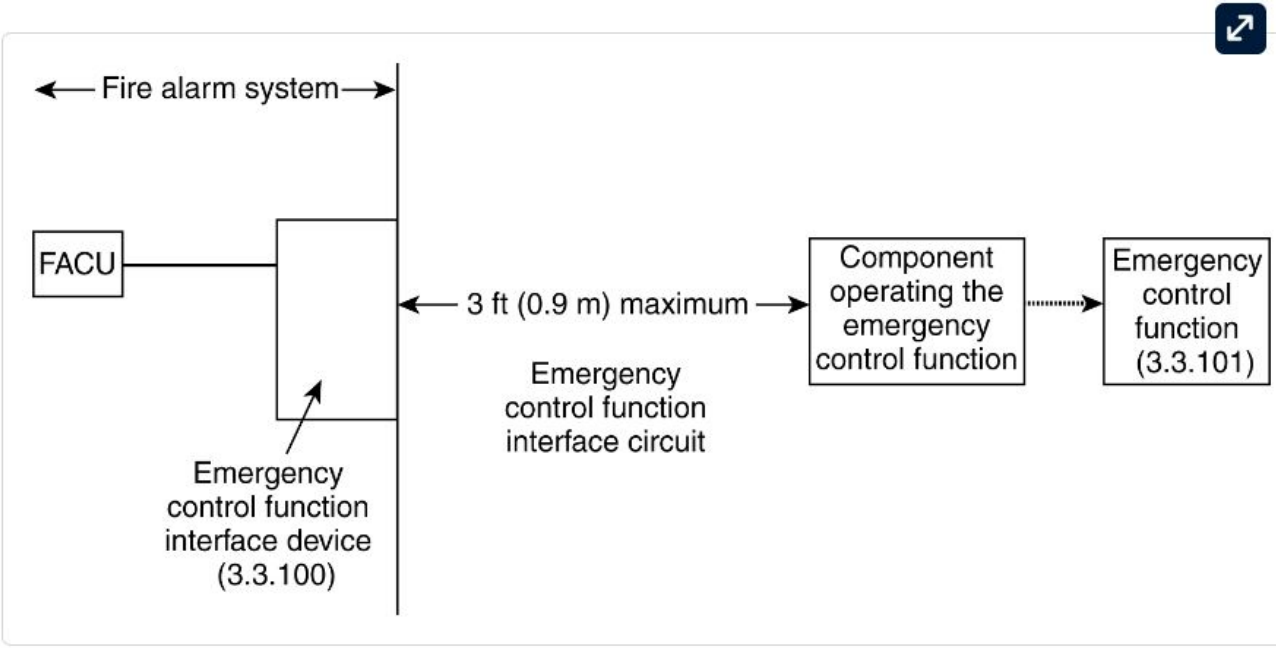

Fire alarm system
FACU
3 ft (0.9 m) maximum
Component operating the emergency control function
Emergency control function (3.3.101)
Emergency control function interface circuit
Emergency control function interface device (3.3.100)

Figure A.3.3.153.1.1 Emergency Control Function Interface.

Elevator Phase 1 Emergency Recall Operation

NFPA 72 - 2022

21.3.3.1 Unless otherwise permitted by 21.3.3.2 or required by the authority having jurisdiction, only the elevator lobby, elevator hoistway, elevator machine room, elevator machinery space, elevator control room, and elevator control space smoke detectors or other automatic fire detection as permitted by 21.3.10 shall be used to initiate Elevator Phase I Emergency Recall Operation.

RA 9514 – Revised IRR – 2019

SECTION 10.2.6.6 FIRE DETECTION, ALARM, AND COMMUNICATION SYSTEMS

F. Emergency Control

3. The functions specified in para 2 above shall be permitted to be activated by any fire alarm and control system, where otherwise not required by RA 9514 and its RIRR. Additionally, such a fire alarm and control system shall be permitted to recall elevators, if the activation of the system for this purpose comes only from elevator lobby, hoistway, or associated machine room detectors.

Elevator Phase 1 Emergency Recall Operation (Continuation)

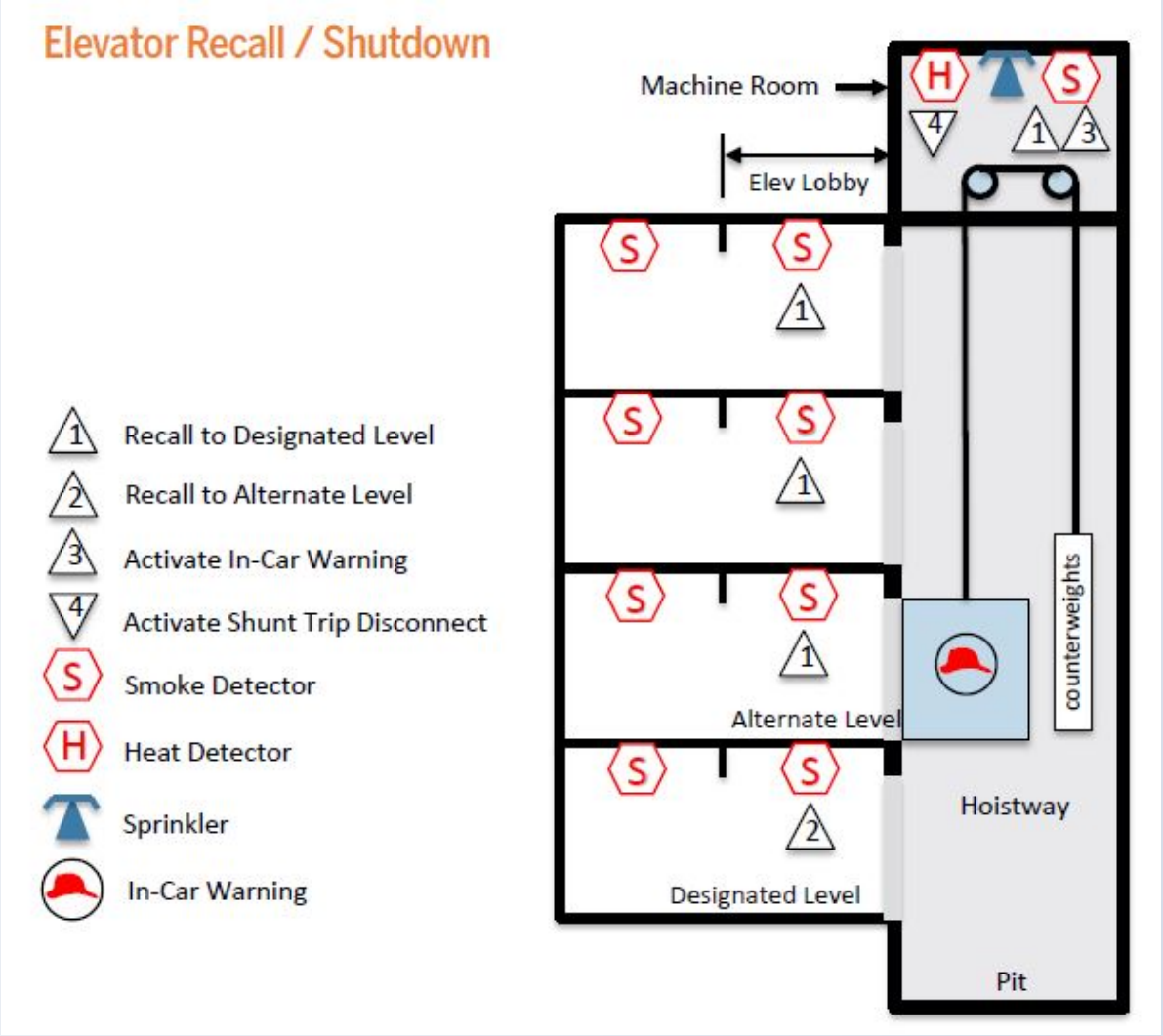
NFPA 72 - 2022

21.3.14 The following three separate outputs from the building fire alarm control unit or the fire alarm control unit to the elevator system shall be provided to implement Elevator Phase 1 Emergency Recall Operation:

(1) Designated level associated output

(2) Alternate level associated output

(3) Elevator machine room, elevator machinery space, elevator control space, or elevator control room associated output

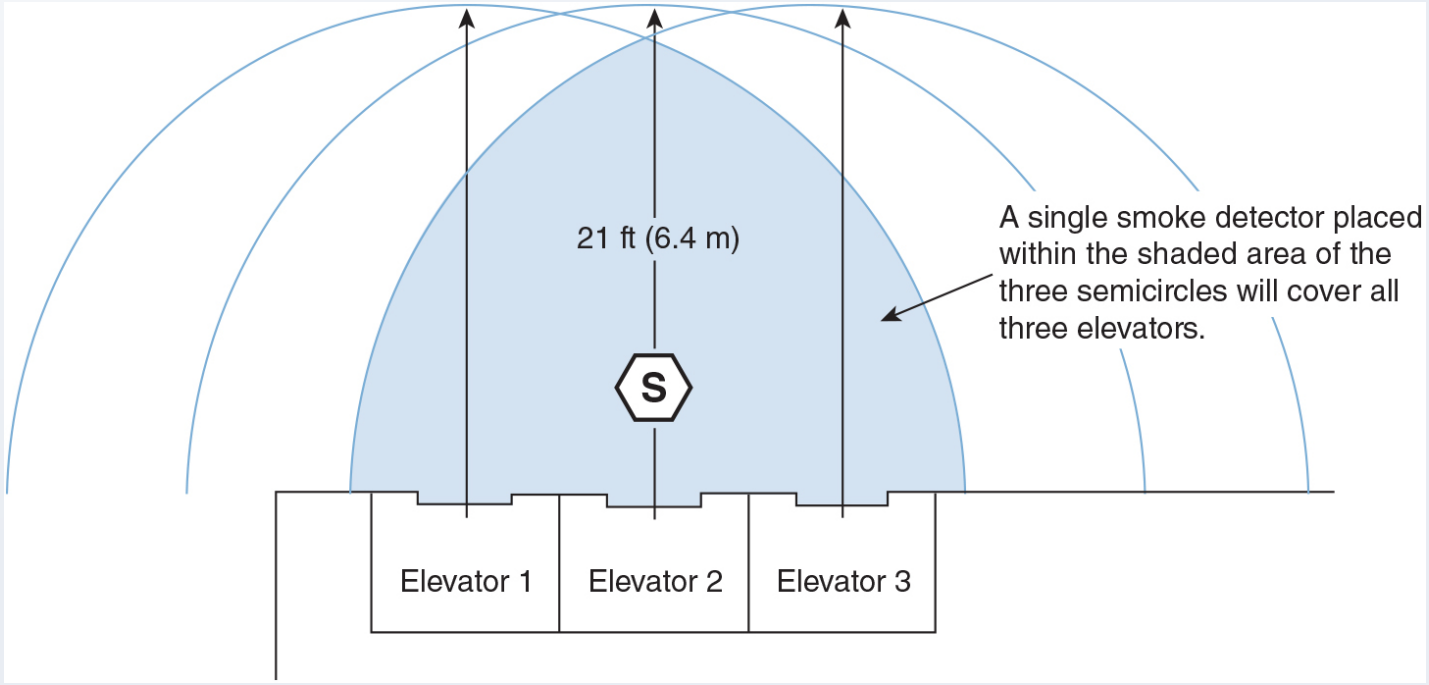


Elevator Phase 1 Emergency Recall Operation (Continuation)

NFPA 72 - 2022

21.3.5.1 A lobby smoke detector shall be located on the ceiling within **21 ft. (6.4 m)** of the centerline of each elevator door within the elevator bank under control of the detector. – *For ceiling not higher than 15 ft. (4.6 m).*

**At elevator landings that have high ceilings in excess of 15 feet, detection should be placed on the wall above and within 60 inches from the top of elevator doors.*


21 ft (6.4 m)
S
A single smoke detector placed within the shaded area of the three semicircles will cover all three elevators.
Elevator 1
Elevator 2
Elevator 3

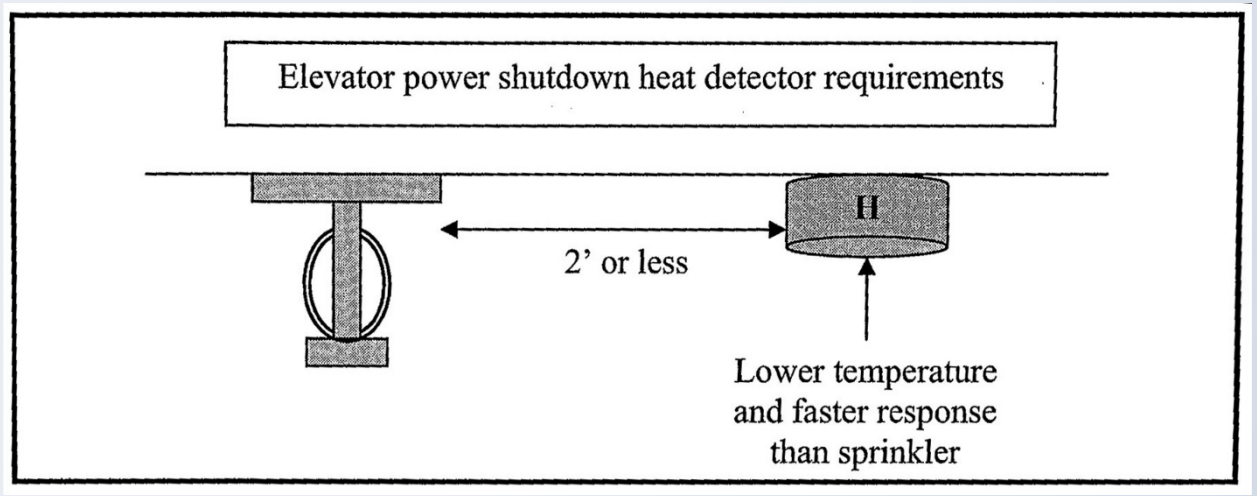
Elevator Shutdown

NFPA 72 - 2022

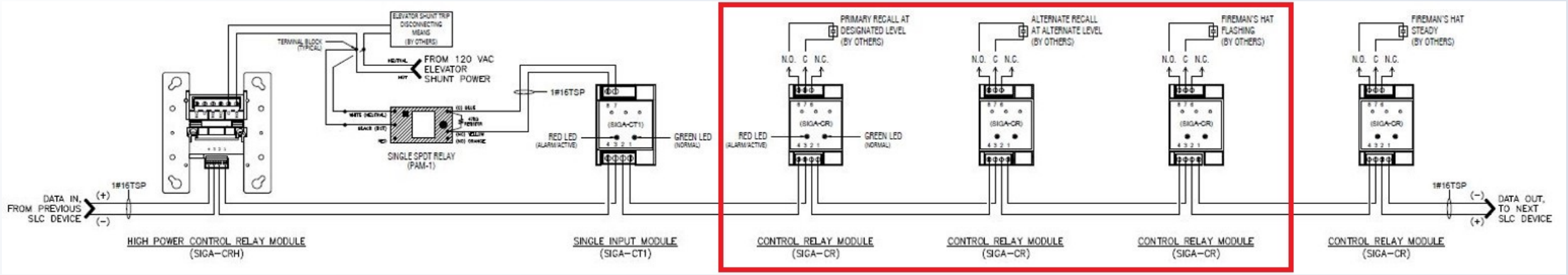
21.4.1 When heat detector(s) are used to actuate the disconnecting means to disconnect the main line power supply to the affected elevator and any other power supplies used to move the elevator, upon or prior to the activation of sprinkler(s), the detector(s) shall have both a **lower temperature rating** and a **lower response time index (RTI)** as compared to the sprinkler(s).

21.4.2 The heat detector(s) specified in 21.4.1 shall be placed within **24 in. (610 mm)** of each sprinkler and be installed in accordance with the requirements of Chapter 17.

21.4.4 Control circuit(s) of the disconnecting means specified in 21.4.1 shall be monitored for the presence of operating voltage.



Example Elevator Interfacing Fire Alarm Connection Diagram


ELEVATOR SHUNT TRIP DISCONNECTING MEANS (BY OTHERS)
TERMINAL BLOCK (TYPICAL)
FROM 120 VAC ELEVATOR SHUNT POWER
SINGLE SPOT RELAY (PAM-1)
1#16TSP
RED LED (ALARM/ACTIVE)
GREEN LED (NORMAL)
(SIGA-CT1)
PRIMARY RECALL AT DESIGNATED LEVEL (BY OTHERS)
ALTERNATE RECALL AT ALTERNATE LEVEL (BY OTHERS)
FIREMAN'S HAT FLASHING (BY OTHERS)
FIREMAN'S HAT STEADY (BY OTHERS)
N.O. C N.C.
(SIGA-CR)
DATA IN, FROM PREVIOUS SLC DEVICE
DATA OUT, TO NEXT SLC DEVICE
(+)
(−)
HIGH POWER CONTROL RELAY MODULE (SIGA-CRH)
SINGLE INPUT MODULE (SIGA-CT1)
CONTROL RELAY MODULE (SIGA-CR)
CONTROL RELAY MODULE (SIGA-CR)
CONTROL RELAY MODULE (SIGA-CR)
CONTROL RELAY MODULE (SIGA-CR)

High Power Control Relay Module

Mechanical Relay

Input Module

Control Relay Module

Smoke Control System

A smoke control system can be defined as an engineered system that uses mechanical fans to produce pressure differences across smoke barriers to inhibit smoke movement.

A smoke control system is a system that controls the movement of smoke and air in a building. It can be made up of multiple different components and use several methods to achieve its design objective, ***which is typically to maintain a tenable environment long enough for all occupants to egress the building.***

Smoke Control System (Continuation)

RA 9514 – Revised IRR – 2019

SECTION 10.2.7.3 SMOKE CONTROL SYSTEMS

B. The design, installation, operation and on-going periodic testing of smoke control systems to the above-mentioned areas of building/structure/facility shall be in accordance with the latest edition of PMEC and NFPA 92, NFPA 204, Standard for Smoke and Heat Venting.

F. The operations and maintenance manual shall provide the requirements to ensure the proper operation of the system over the life of the building. The building administrator/ owner shall be responsible for all system testing and shall maintain records of all periodic testing and maintenance in accordance with the operations and maintenance manual which shall include the following:

5. Operational testing of the smoke-control systems shall be in accordance with NFPA 92, and shall include all equipment related to the system including, but not limited to, initiating devices, fans, dampers, controls, doors, and windows;

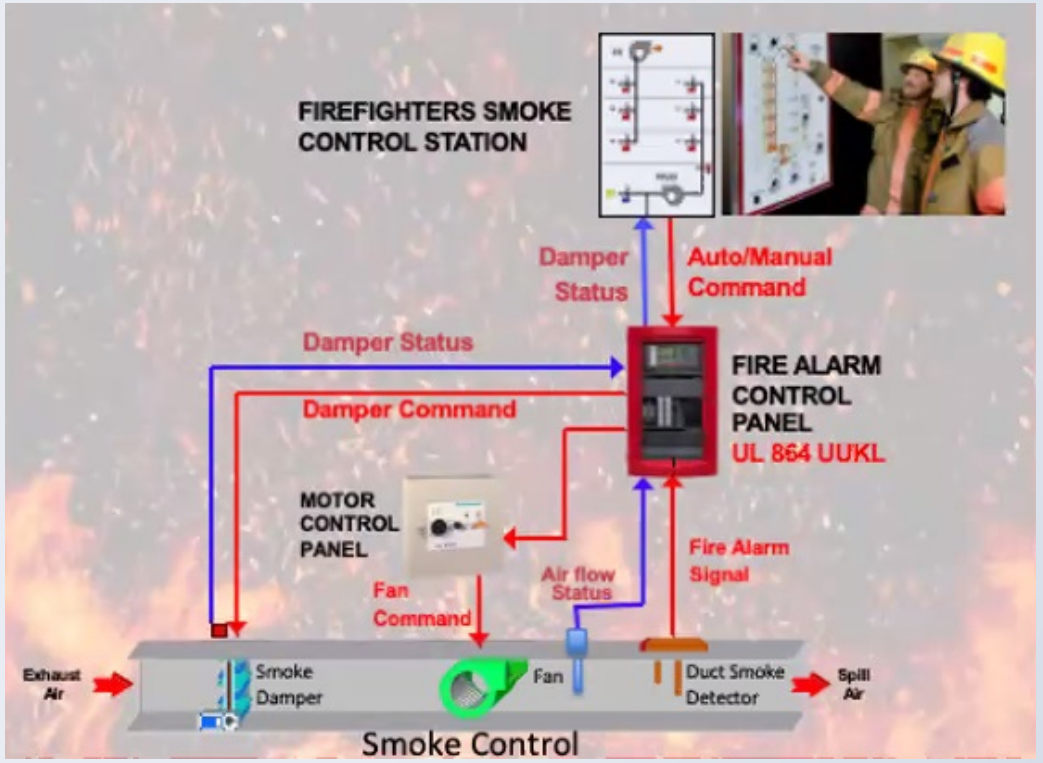
Smoke Control System (Continuation)

NFPA 92 (Standard for Smoke Control Systems) 2024 Edition

6.4 Smoke Control Systems.

6.4.1 Control systems shall be listed in accordance with UL 864, *Control Units and Accessories for Fire Alarm Systems*, as smoke control system equipment. **Category UUKL**

Smoke Control by UL 864 UUKL Listed Fire Alarm System

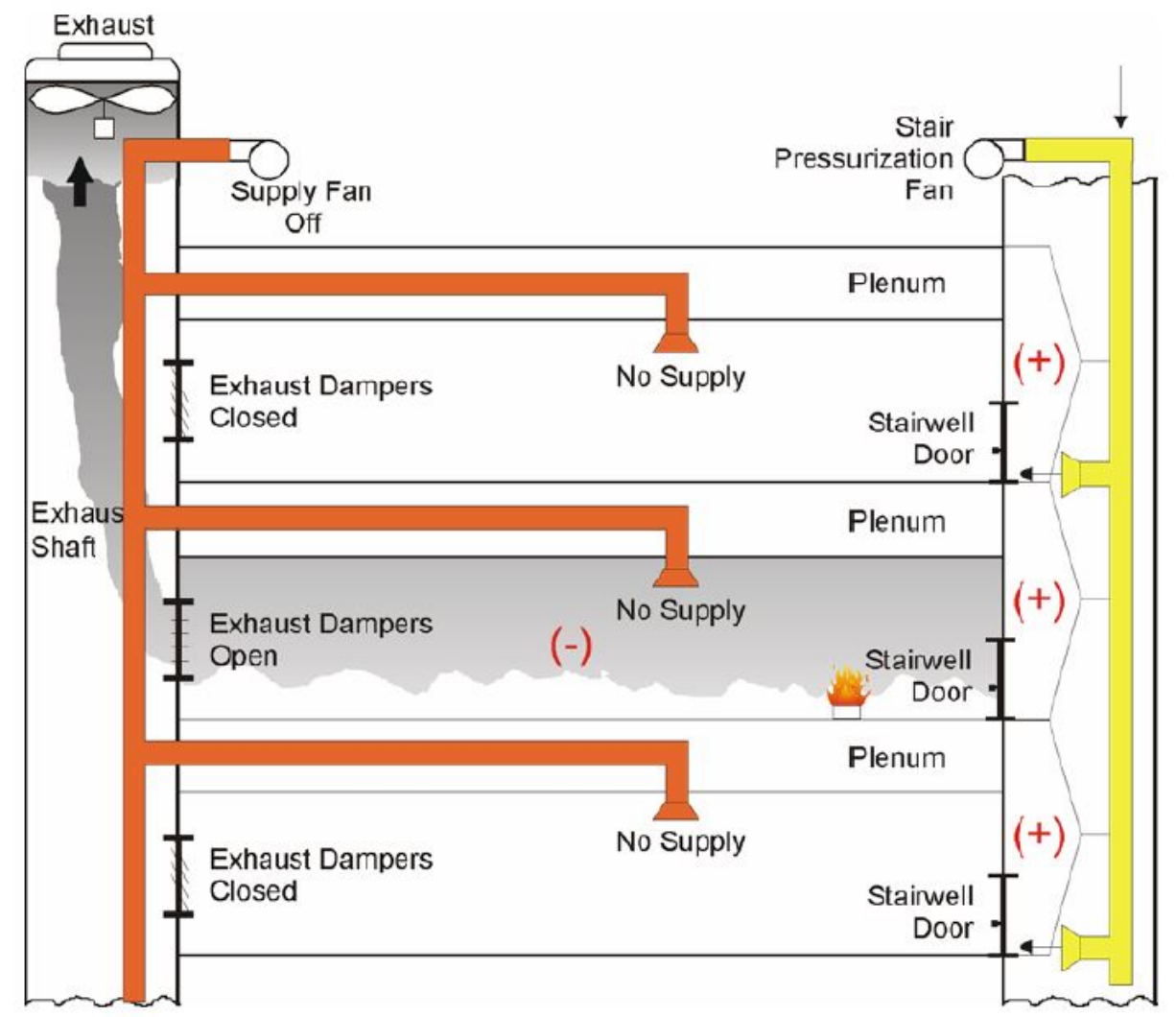


Smoke Control System (Continuation)

In case of fire in a high rise building, a Stair Pressurization Fan (SPF) uses clean outside air to pressurize the air in stairwells. The pressurization is used to push back on smoke, keeping the smoke out of the escape route. The pressurized air helps people escape the fire and fire fighters battle the fire.

Both smoke management and smoke containment systems are automatically activated by one or more fire detection devices including sprinkler waterflow, smoke detectors, and heat detectors.

Manual pull stations should not be used for smoke control systems that need to know the location of the fire since the likelihood of someone activating the smoke control system in the area of fire origin is low.



Smoke Control System (Continuation)

NFPA 92 (Standard for Smoke Control Systems) 2024 Edition

6.4.7.3 Zoned smoke control systems shall not be activated from manual fire alarm pull stations.

A.6.4.7.3 Manual pull stations are not used to activate zoned smoke containment strategies because these types of system require information on the location of the fire, and there is no assurance that the pull station that was activated is located in the smoke zone.

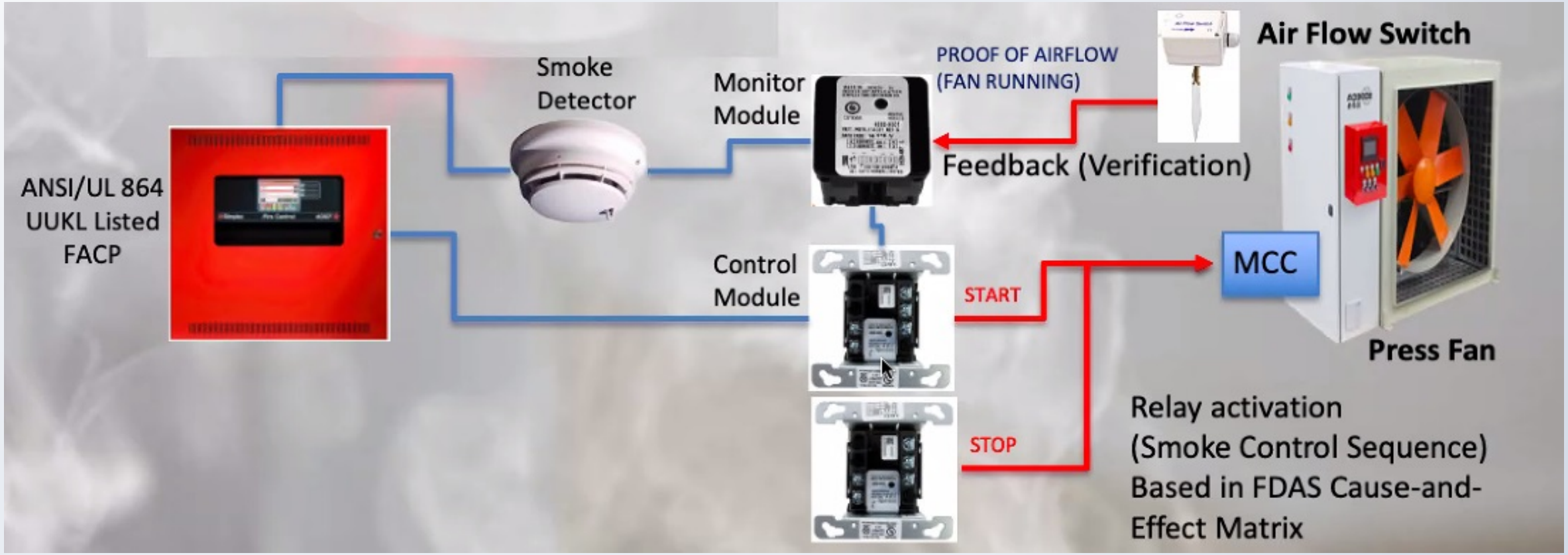
Control System Verification

6.4.8.1 Every dedicated smoke control system and each dedicated smoke control subsystem in a nondedicated smoke control system shall have means of verifying correct operation when activated.

Smoke Control System (Continuation)

- *End-to-end verification is required to ensure that the smoke control sequence of operation has been implemented.*

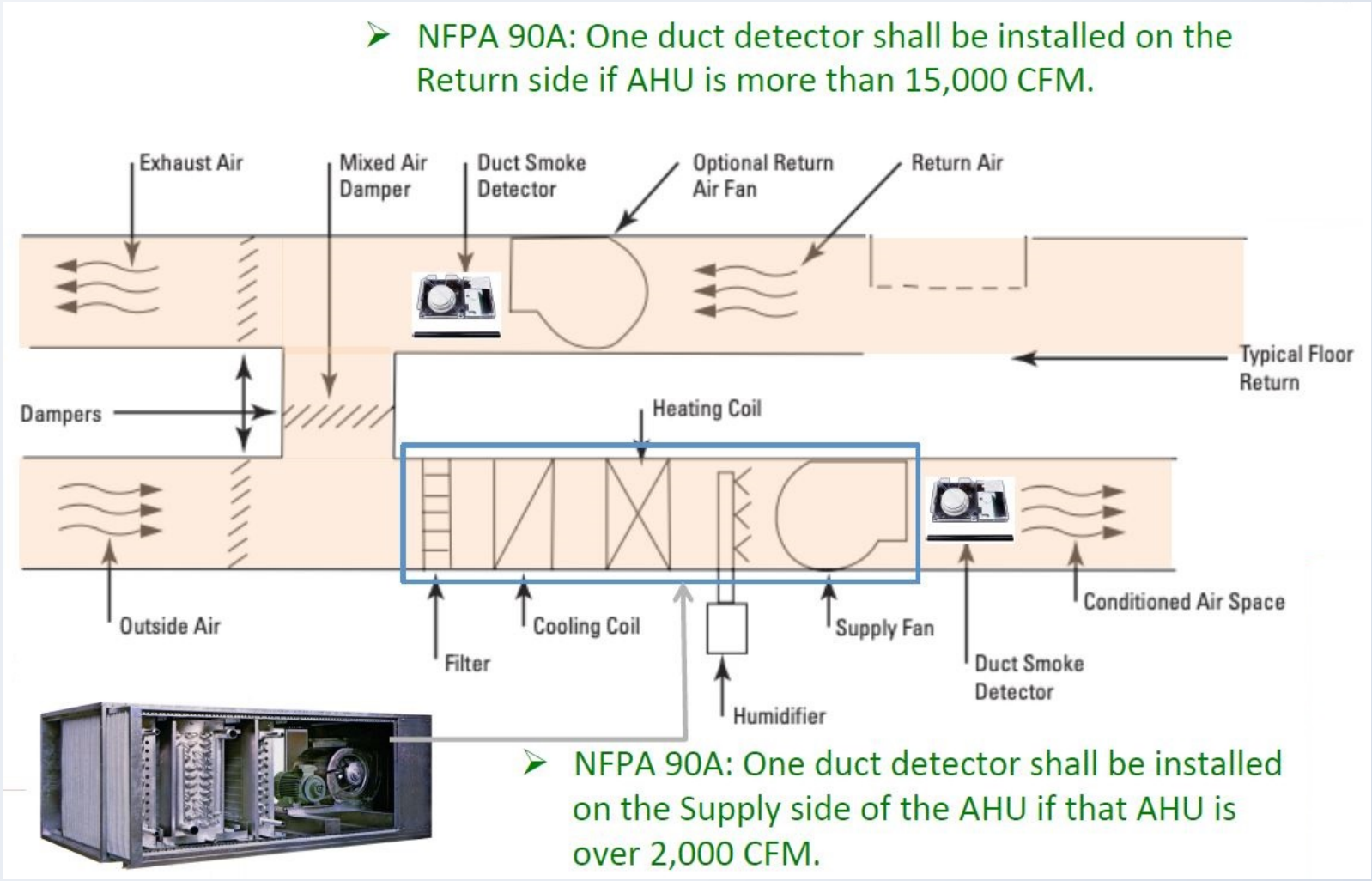
- *Verification shall be accomplished by using damper position indicators and airflow switches or differential pressure sensors.*



Heating Ventilating and Air Conditioning (HVAC) System

Air Handling Unit (AHU)

- *Used to condition and circulate air as part of HVAC system.*
- *A large metal box containing a blower, heating or cooling elements, filter racks or chambers, humidity and temperature control loops.*


NFPA 90A: One duct detector shall be installed on the Return side if AHU is more than 15,000 CFM.
Exhaust Air
Mixed Air Damper
Duct Smoke Detector
Optional Return Air Fan
Return Air
Typical Floor Return
Dampers
Heating Coil
Outside Air
Filter
Cooling Coil
Humidifier
Supply Fan
Duct Smoke Detector
Conditioned Air Space
NFPA 90A: One duct detector shall be installed on the Supply side of the AHU if that AHU is over 2,000 CFM.

Duct Smoke Detector Placement Consideration

NFPA 90A (Standard for the Installation of Air-Conditioning and Ventilating Systems) 2024 Edition

11.4.2.1 Smoke detectors listed for use in air distribution systems shall be located as follows:
(1) Downstream of the air filters and ahead of any branch connections in air supply systems having a capacity greater than **944 L/sec (2,000 cfm)**
(2) At each story prior to the connection to a common return and prior to any recirculation or fresh air inlet connection in air return systems having a capacity greater than **7,080 L/sec (15,000 cfm)** and serving more than one story

Fire and Smoke Damper

Fire and smoke dampers are used to reduce the spread of fire and smoke throughout a building and the building's heating, ventilation, and air conditioning (HVAC) system.

Common Types of Dampers:

1.) Fire Dampers

2.) Smoke Dampers

3.) Combination Fire/Smoke Damper

Fire Dampers

A device that is designed to close automatically upon detection of heat (such as a fusible link or heat detector) and to interrupt airflow and to restrict the passage of flame.

Multi-blade Fire Damper

Interlocking Blade Fire Damper

Smoke Dampers

A device within an air-distribution system that controls the movement of smoke by halting air movement automatically upon the detection of smoke (such as a smoke detector).

Smoke Dampers

Combination Fire/Smoke Damper

It may be necessary to provide both a fire damper and a smoke damper in the same place. In that case, a fire/smoke damper can be used to meet both the fire damper and smoke damper requirements.

Door and Shutter Release

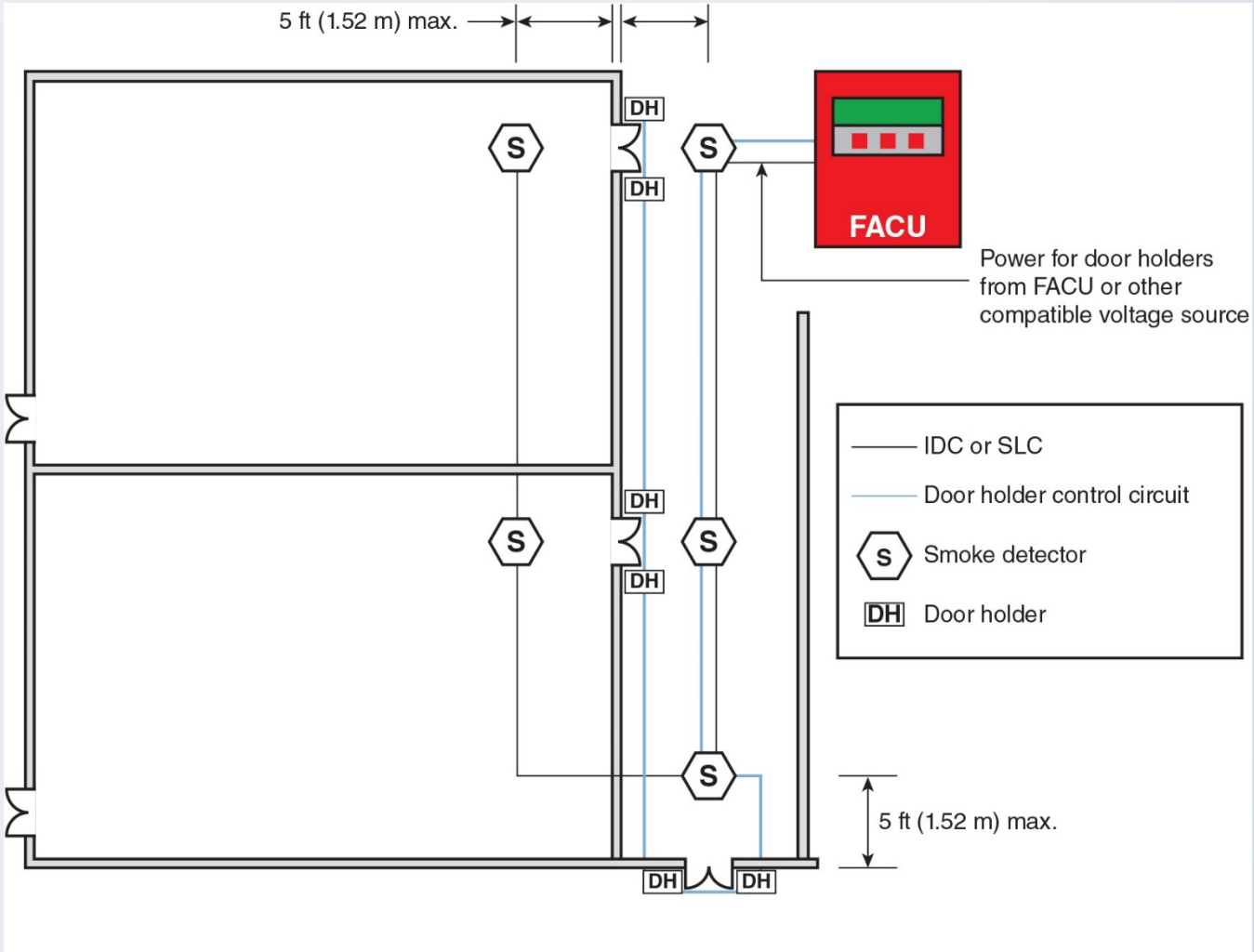
- ***Fire Shutters*** *are normally Open on normal condition and Closes to act as barrier in the event of fire to prevent the spread of fire or smoke.*

- ***Fire Doors*** *must be self-closing to ensure the door closes to act as barrier to stop the smoke or fire from spreading. Use electromagnet to hold open fire doors that will release (close) in the event of a fire.*

Smoke Detectors for Door Release Service

NFPA 72 - 2022

17.7.6.6.1 Smoke detectors that are part of an open area protection system covering the room, corridor, or enclosed space on each side of the smoke door and that are located and spaced as required by 17.7.4 shall be permitted to accomplish smoke door release service.



Supplementary Equipment

Textual and Graphical Visual Appliances

NFPA 72 - 2022

18.9.1.1 Textual and graphical visual appliances shall be permitted to be used to signal information about fire or other emergency conditions or to direct intended responses to those conditions.

**Annunciator* *represents a typical textual visual appliance.*

3.3.21 **Annunciator**

A unit containing one or more indicator lamps, alphanumeric displays, or other equivalent means in which each indication provides status information about a circuit, condition, or location.

10.18.3.1 All required annunciation means shall be readily accessible to responding personnel.

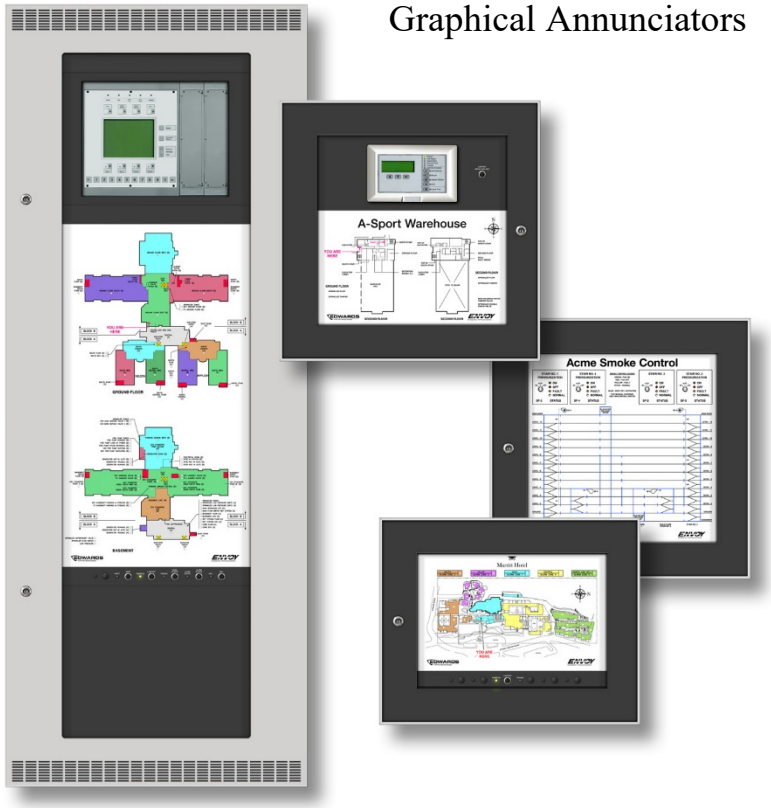
10.18.3.2 All required annunciation means shall be located as required by the authority having jurisdiction to facilitate an efficient response to the situation.

Two kinds of Annunciator:

1.) Active = functions like the main fire alarm control panel.

2.) Passive = is composed of LEDs wherein each LED represents a location or zone for indication of alarm.

Graphical Annunciators



LCD Annunciator

LCD Annunciator with Controls

Graphical Command/Control Workstation

System Event Printer

LED Annunciators

Key Takeaways:

- Awareness on the Classification of Occupancy as per RA 9514 - Revised IRR - 2019.
- Awareness on the Fire Detection & Alarm System components design and installation standards.

"You need to be aware of what others are doing, applaud their efforts, acknowledge their successes, and encourage them in their pursuits. When we all help one another, everybody wins."
- Jim Stovall

Questions ???

ANGELO N. OLERMO
Electronics Engineer
NICET # 143011, Fire Alarm Systems

Email: angelo_olermo@hotmail.com
Mobile: 0925-5222235

Facebook group:
Fire Alarm & Signaling System Philippines